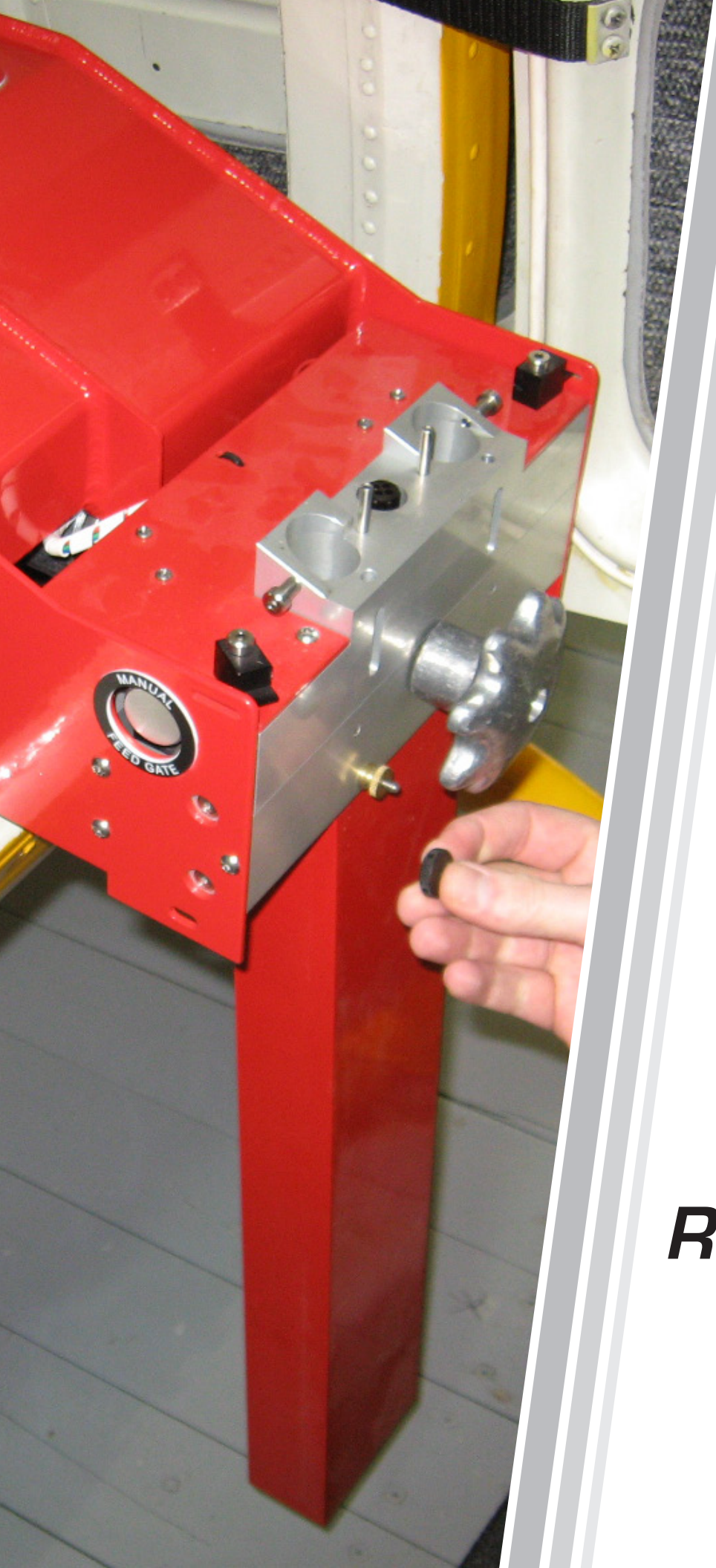

SEI INDUSTRIES

DRAGON®
FIRE IGNITION PRODUCTS

RED DRAGON SERVICE MANUAL

2015 VERSION C

RED DRAGON SERVICE MANUAL - Version C

Issue Date: FEBRUARY 2015

PLEASE READ BEFORE USING.

SEI INDUSTRIES LTD.
7400 Wilson Avenue
Delta, B.C. Canada
V4G 1E5

Phone: (604) 946-3131
Fax: (604) 940-9566
E-Mail: seisales@sei-ind.com
Website: www.sei-ind.com

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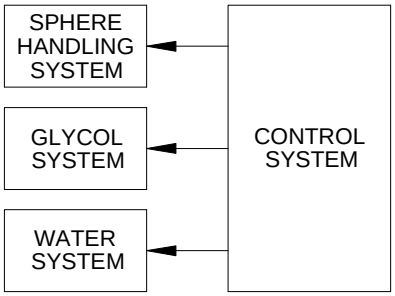
Section 1: Introduction

Manual Overview

This service manual complements the Red Dragon operator's manual. It is intended to provide enough information so that all service required on the machine can be performed locally.

Manual Organization

The dispenser's functions have been organized into four major systems. Sections two through five in the manual correspond to each of these systems.



Each section begins with a description of how the components of the system operate. Following that description are expanded drawings that identify the system components in detail.

Finally, there are multiple troubleshooting procedures to identify common problems and offer possible solutions. Once a problem has been diagnosed, section six details the repair procedures for all systems. Section seven is a supplier cross reference for the non-proprietary parts used in the dispenser.

Skills Required

The service person needs to have an average mechanical aptitude and be competent in repairs with basic hand tools. He/she also needs to be able to operate a multi-meter to perform continuity and voltage measurements.

Tools Required

In addition to the tools provided in the Red Dragon tool kit, the following tools may also be required to perform troubleshooting and repairs.

- multi-meter with voltage and continuity ranges
- 0.050, 1/16, 5/64, 3/32, 7/64, 9/64, and 5/32 hex keys
- # 2 Phillips screwdriver
- 1/4, 11/32, 3/8 and 1/2 combination wrenches
- 10mm, 12mm, and 14mm combination wrenches

Safety

Some of the troubleshooting routines require testing to be done while the unit is connected to an external power supply. While the power supply is only 24V DC, caution should be taken when working on live electrical circuits.

Section 2: Sphere Handling System

Description

The purpose of the sphere handling system is to move the ignition spheres from the hopper, through the injection head, to exit the aircraft.

Hopper

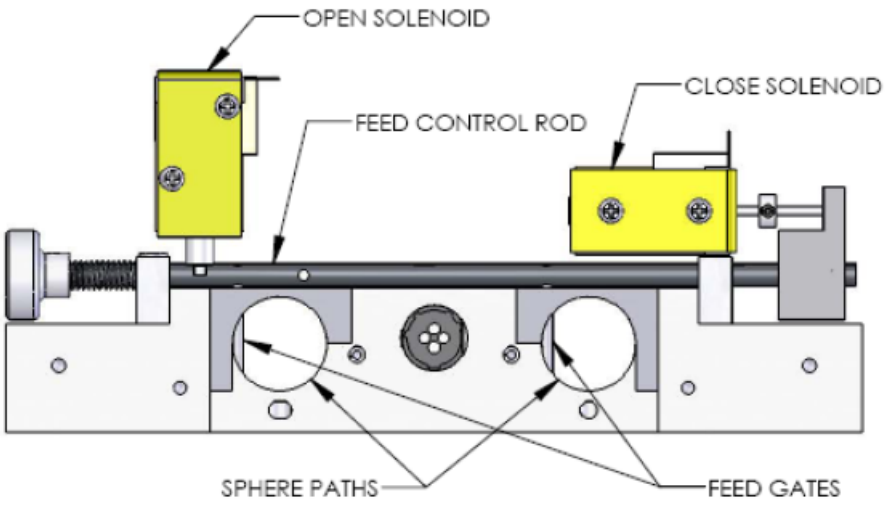
The hopper is an open top container that stores the unprimed spheres. On the bottom of the hopper is an oscillating agitator which directs the spheres into one of two chutes. The lower ends of the chutes extend past the body of the hopper and connect to the top of the gate assembly.

There are spring loaded stops located at the exits of the chutes. When the hopper is removed from the gate assembly, these stops close to prevent the flow of spheres from the hopper. When the hopper is returned to the machine, pins located on the gate assembly open the hopper stops.

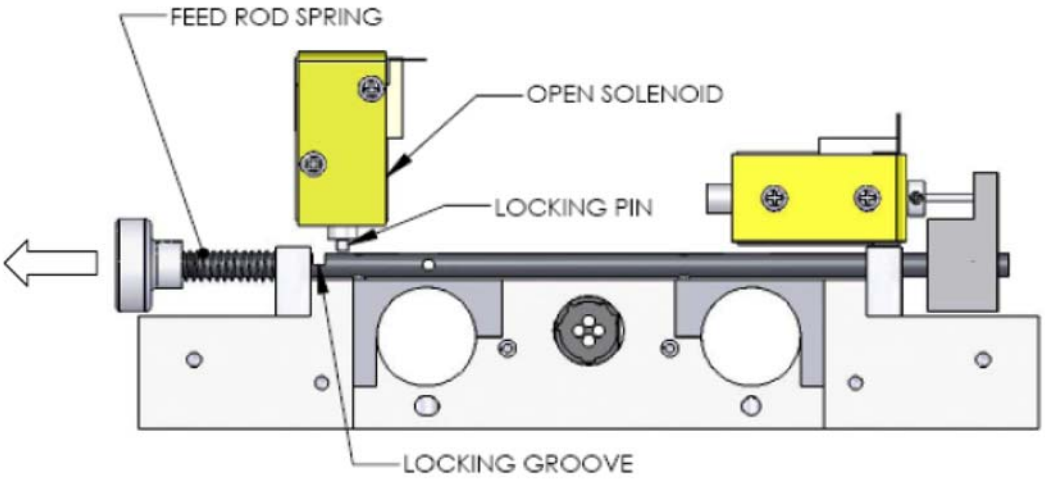
The hopper agitator is driven by a motor through a cam and linkage. Power to the hopper motor is supplied from the gate assembly via a multi-pin connector that automatically mates when the hopper is installed onto the gate assembly.

Gate

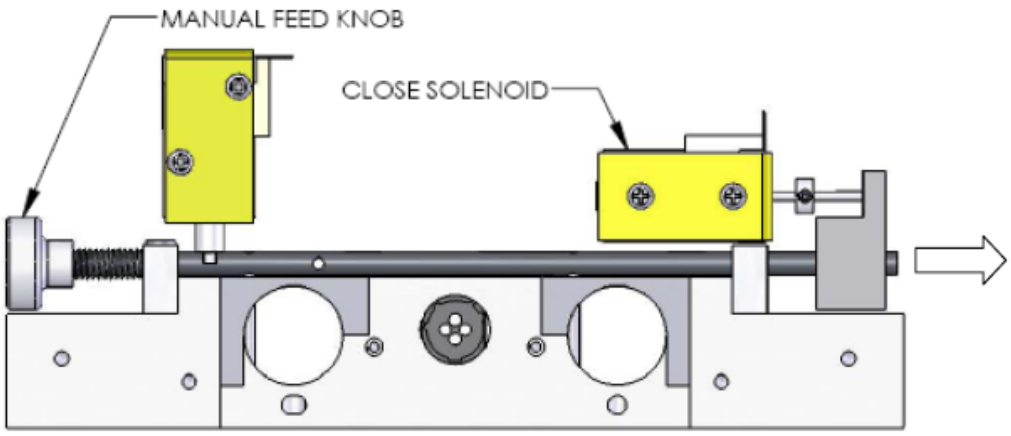
The gate assembly controls the flow of spheres from the hopper into the injection head. As the spheres exit the hopper, they enter two vertical sphere paths in the feed gate assembly. Each path is blocked by a feed gate. These are cylindrical pins attached to a common feed control rod. The position of the feed control rod and feed gates is controlled by two solenoids under direction from the microprocessor (see *Section 5: Control System*).



When the open solenoid is energized, it withdraws a spring loaded locking pin from the groove in the feed control rod. Once the feed control rod is unlocked, the feed rod spring forces the feed control rod to move outwards, unblocking the sphere paths.

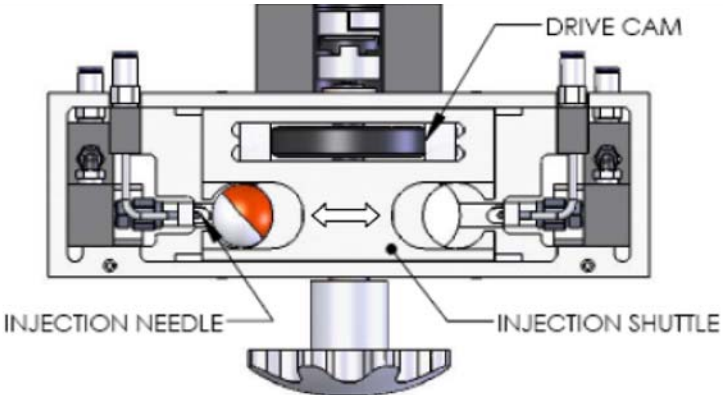


When the close solenoid is energized, it pushes the feed control rod inwards, causing the feed gates to block the flow of spheres through the passages. The spring loaded pin re-enters the groove in the feed control rod and locks the gates closed. In an emergency, the feed gate can be closed and locked by pushing the manual feed gate knob located on the end of the feed control rod.

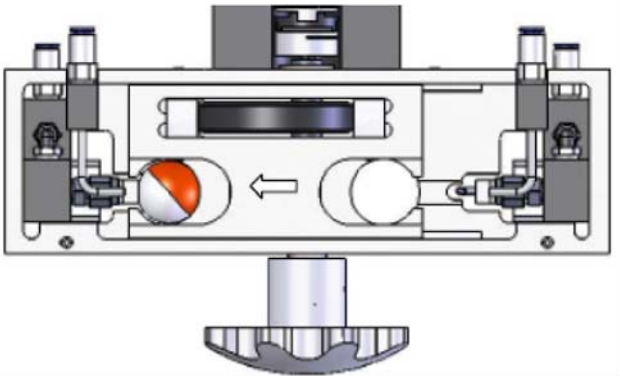


Injection Head

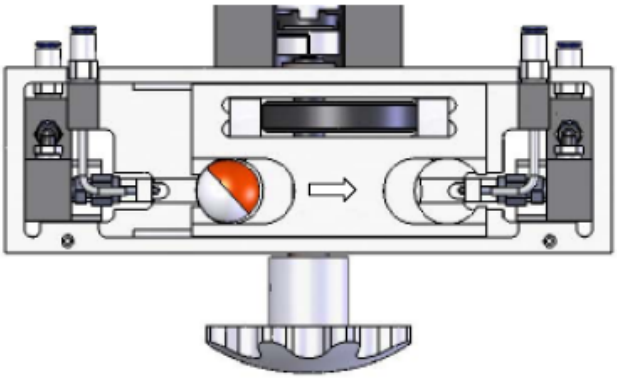
As a sphere exits the feed gate assembly, it falls into one of the cavities in the injection shuttle. The shuttle is driven in a reciprocating motion by the drive motor and the drive cam.



Outward motion of the shuttle causes the sphere to contact the injection needle and be injected with glycol. For details of the injection process, see *Section 3: Glycol System.*



When the shuttle reverses direction, the sphere is extracted from the needle and transported to a point over the exit chute. The sphere falls through a hole in the bottom of the injection head and into the exit chute.

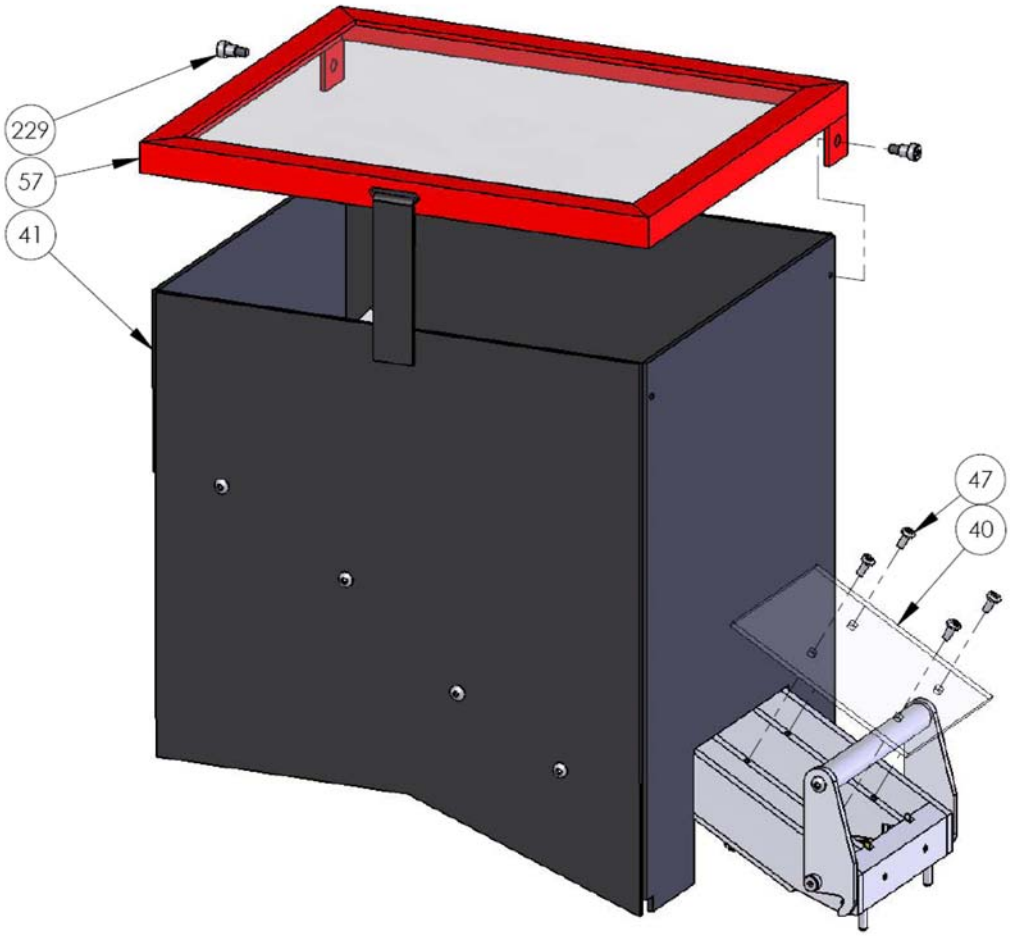


Exit Chute

The exit chute contains the spheres until they have reached a point below the aircraft to ensure that no live spheres enter the aircraft.

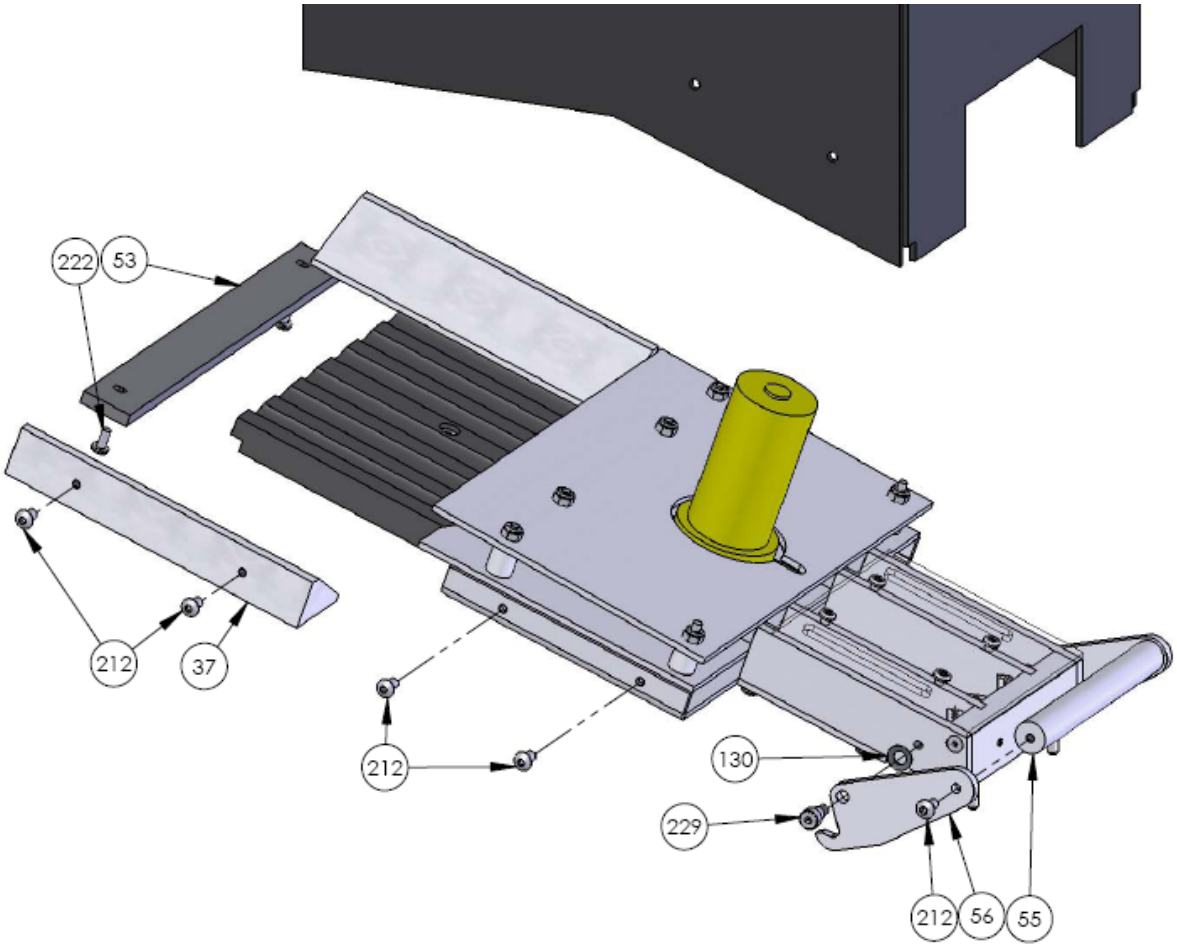
Sphere System Components

Hopper



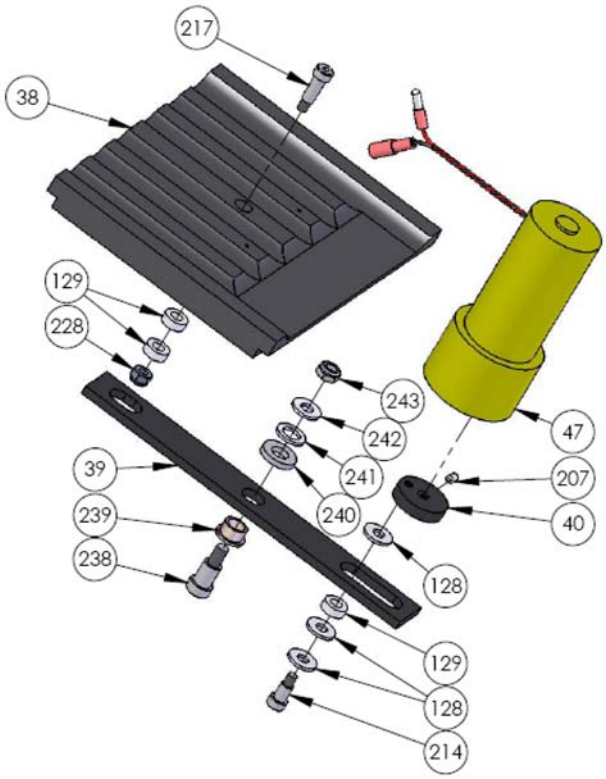
Item	Description	Part #	Qty
41	HOPPER FABRICATION	DE13510	1
46	CHUTE WINDOW	DE13515	1
57	HOPPER LID	DE13532	1
222	MACHINE SCREW, PHILLIPS, SS, # 8-32 X 3/8	000487	4
229	SHOULDER BOLT, SS, 1/4 X 1/4 X # 10-32	000553	2

Hopper (continued)



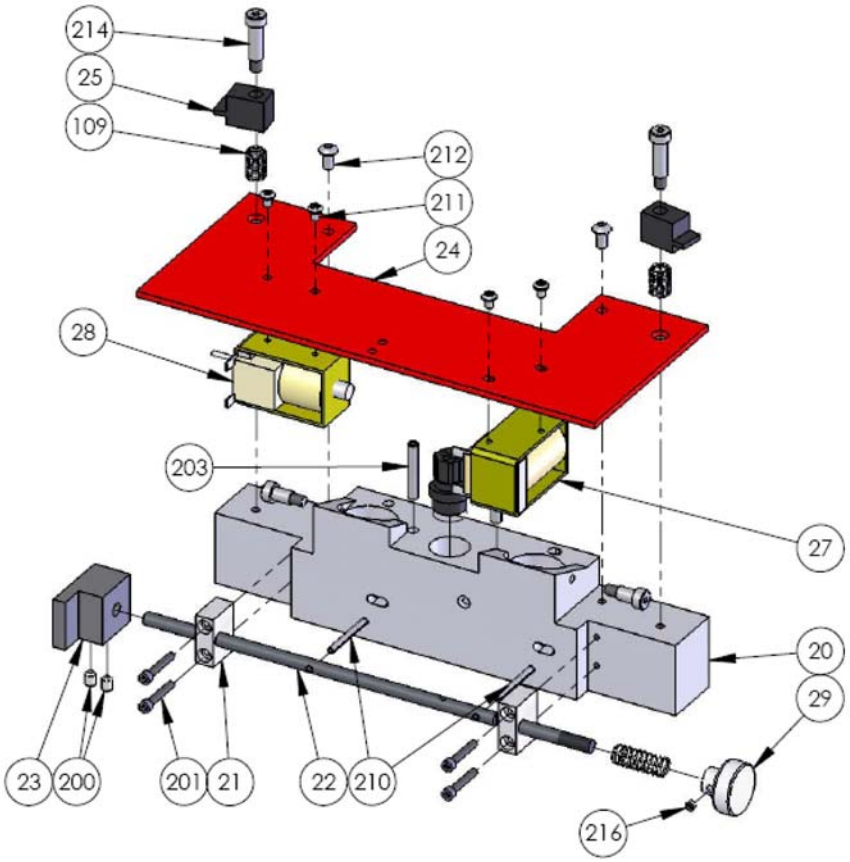
Item	Description	Part #	Qty
37	HOPPER DEFLECTOR	DE13506	2
53	AGITATOR ADJUSTER	DE13525	1
55	LOCK HANDLE	DE13527	1
56	LOCK PLATE	DE13528	2
130	DISC SPRING	005992	2
212	BUTTON HEAD CAPSCREW, SS, # 10-24 X 3/8	000513	8
222	MACHINE SCREW, PHILLIPS, SS, # 8-32 X 3/8	000487	2
229	SHOULDER BOLT, SS, 1/4 X 1/4 X # 10-32	000553	2

Hopper (continued)



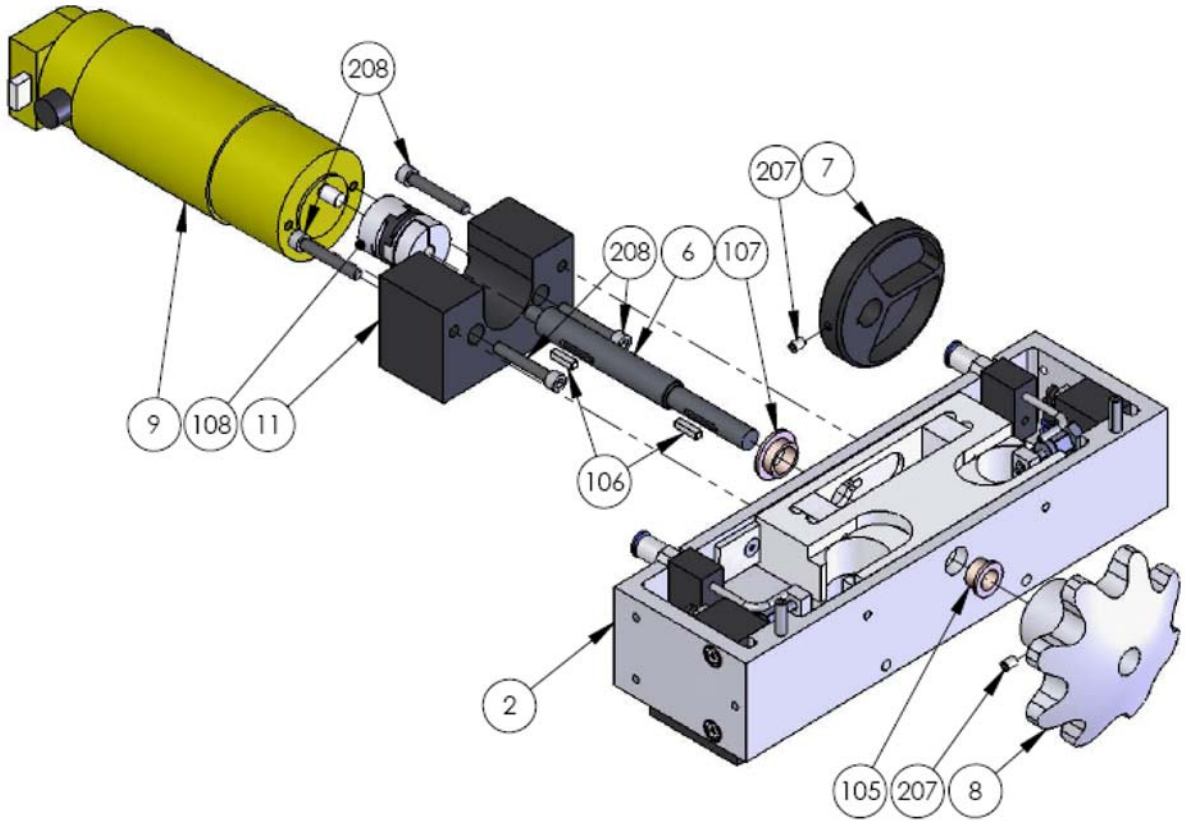
Item	Description	Part #	Qty
38	AGITATOR PLATE	DE13507	1
39	AGITATOR LINKAGE	DE13508	1
40	AGITATOR CAM	DE13509	1
47	HOPPER MOTOR	DE13517	1
128	BUSHING, STRAIGHT, NYLON, 1/4 X 5/8 X 1/16	005138	3
129	BUSHING, STRAIGHT, NYLON, 1/4 X 1/2 X 3/16	005985	3
207	SETSCREW, SS, # 8-32 X 1/4	000364	1
214	SHOULDER BOLT, SS, 1/4 X 3/8 X # 10-32	000554	1
217	SHOULDER BOLT, SS, 1/4 X 5/8 X # 10-32	000556	1
228	NUT, NYLOCK, SS, 10-32	001685	1
238	BOLT, 3/8 X 1/2 X 1/4 – 20, SH, HX SS	006411	1
239	BUSHING, FL, BRZ, 3/8 X 1/2 X 5/16	005982	1
240	WASHER, FLT, 3/8 X 3/4, BRZ	006412	1
241	WASHER, FLT, 3/8 X 5/8, AN, SS	001835	1
242	WASHER, FLT, 1/4 X 5/8, SAE, SS	001819	1
243	NUT, JAM, NYL, 1/4 – 20, HX, SS	001663	1

Gate Assembly



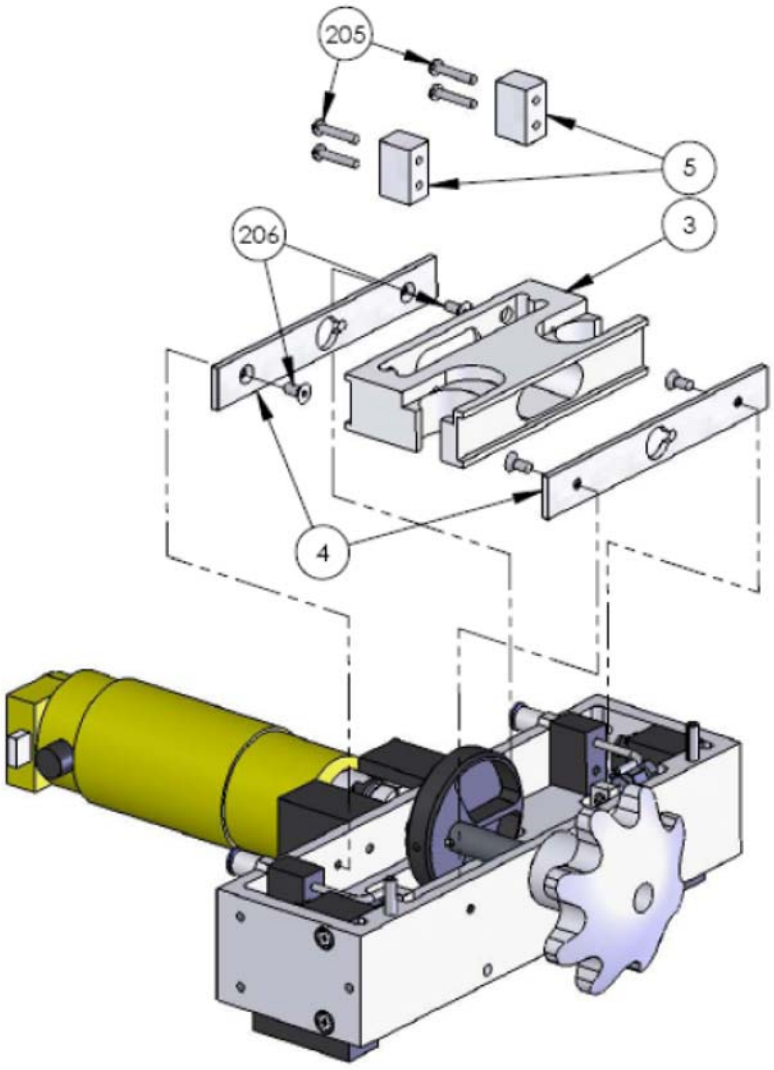
Item	Description	Part #	Qty
20	GATE BLOCK	DE13301	1
21	PILLOW BLOCK	DE13302	2
22	FEED CONTROL ROD	DE13303	1
23	SOLENOID ACTIVATOR	DE13304	1
24	SOLENOID COVER	DE13305	1
25	GATE LOCK	DE13306	2
27	OPEN SOLENOID ASSY	DE13308	1
28	CLOSE SOLENOID ASSY	DE13309	1
29	MANUAL FEED CONTROL KNOB	DE13310	1
109	SPRING, PLATED	005990	2
200	SETSCREW, # 10-32 X 1/4	000525	1
201	SOCKET HEAD CAPSCREW, SS, # 6-32 X 7/8	000414	4
203	SPLIT PIN, SS, 3/16 X 1-1/4	001739	2
210	SPLIT PIN, SS, 1/8 X 1-1/4	001738	2
211	MACHINE SCREW, PANPHIL, SS, # 6-32 x 1/4	011696	4
212	BUTTON HEAD CAPSCREW, SS, # 10-24 X 3/8	000513	2
213	SHOULDER BOLT, SS, 1/4 X 3/4 X # 10-32	000557	2
214	SHOULDER BOLT, SS, 1/4 X 3/8 X # 10-32	000554	2
216	SETSCREW, # 8-32 X 1/8	000363	1

Injection Head



Item	Description	Part #	Qty
2	INJECTION HEAD	DE13201	1
6	DRIVE SHAFT	DE13205	1
7	DRIVE CAM	DE13206	1
8	HAND WHEEL	DE13207	1
9	DRIVE MOTOR	DE13210	1
11	MOTOR MOUNT	DE13215	1
105	OILITE BUSHING, 3/8 X 1/2 X 5/16	005982	1
106	KEY, 1/8 X 1/8 X 1/4	005083	1
107	OILITE BUSHING, 1/2 X 5/8 X 1/4	005109	1
108	SHAFT COUPLING	005137	1
207	SETSCREW, # 8-32 X 1/4	000364	2
208	SOCKET HEAD CAPSCREW, SS, # 10-32 X 1-1/4	000536	4

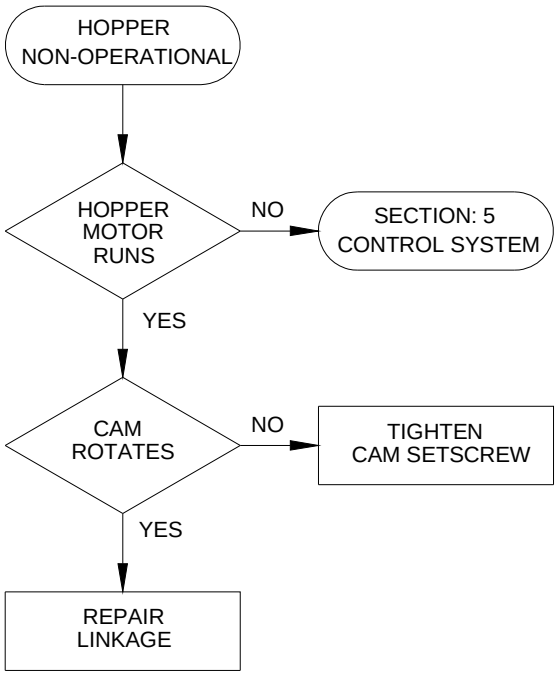
Injection Head (continued)



Item	Description	Part #	Qty
3	INJECTION SHUTTLE	DE13202	1
4	SHUTTLE GUIDE	DE13203	2
5	CAM GUIDE	DE13204	2
205	MACHINE SCREW, PHILLIPS, SS, # 6-32 X 3/4	000484	4
206	MACHINE SCREW, FLAT SOC, SS, # 8-32 X 3/8	000442	4

Sphere System Troubleshooting

Hopper Agitator Non-Operational



Control System

- Set the “RUN / STOP” switch to “RUN.”
- If the hopper motor does not run, go to *Section 5: Control System*.

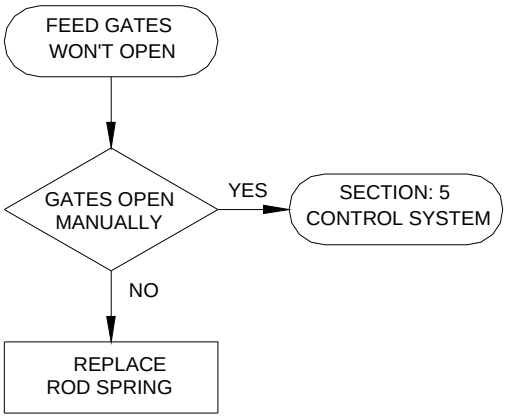
Cam Setscrew Loose

- If the cam rotates, align the cam setscrew with the flat on the hopper motor shaft and tighten the setscrew.

Agitator Linkage Damaged

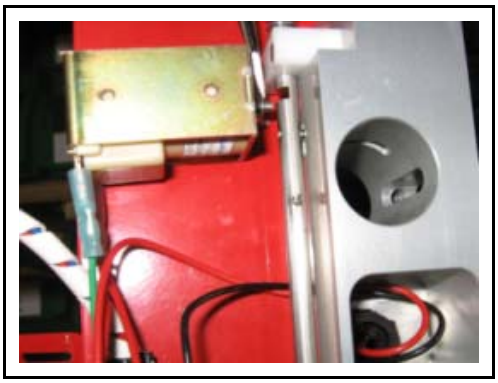
- Inspect and repair the agitator linkage.

Feed Gates Won't Open



Control System

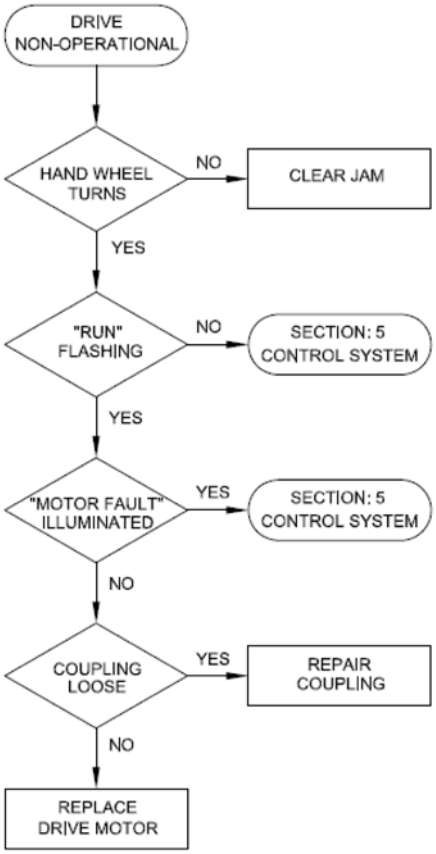
- Ensure that the drive motor is stopped.
- Remove the gate assembly.
- Use a screwdriver to lift the locking pin and unlock the feed control rod.
- If the gates open go to *Section 5: Control System*.



Feed Control Rod Spring Damaged

- Replace the feed control rod spring.

Drive Mechanism Non-Operational



Hand Wheel Turns

- Remove the gate assembly.
- Rotate the manual hand wheel.
- If the hand wheel does not turn, clear the jam.

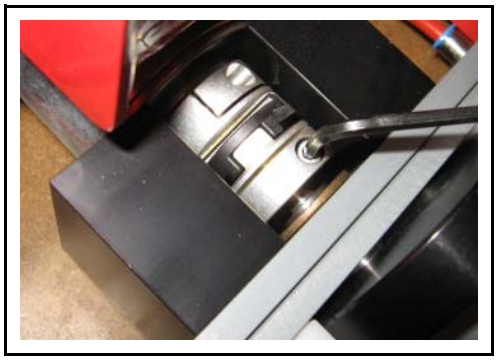
Control System

- Set the “RUN / STOP” switch to “RUN.”
- Press the gate switch on the remote control to “OPEN.”
- If the “RUN” indicator on the main control panel is not flashing, go to *Section 5: Control System.*
- If the “MOTOR FAULT” indicator on the main control panel is illuminated, go to *Section 5: Control System*.

Motor Coupling

- If neither hub is turning, tighten the motor shaft hub.

- If both hubs are turning, tighten the drive shaft hub.

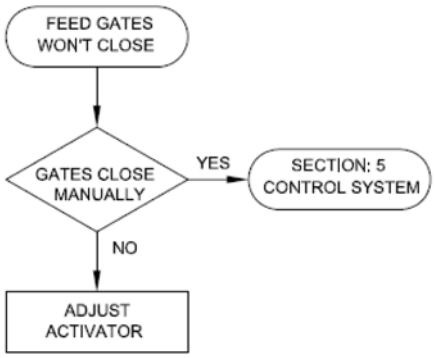


- If only the drive motor hub is turning, replace the coupling.

Damaged Motor Gearbox

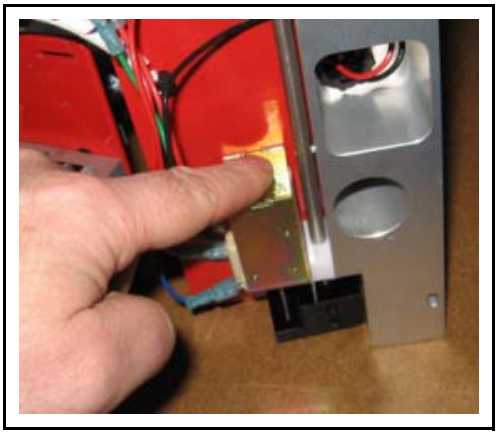
- Replace the drive motor.

Feed Gates Won't Close



Control System

- Remove the gate assembly.
- Press on the close solenoid core to try to close the gates.
- If the gates close and lock, go to *Section 5: Control System.*



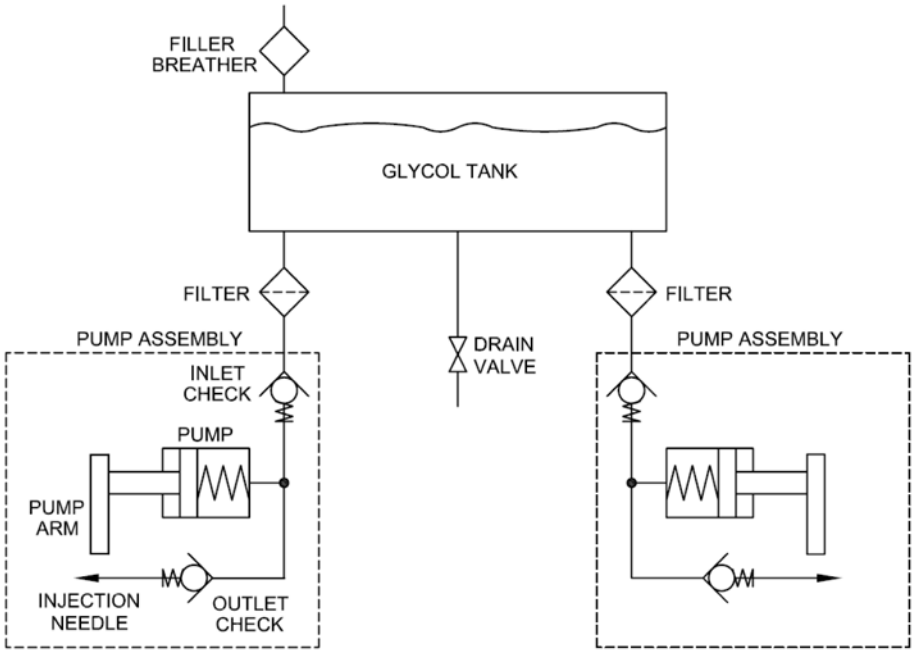
Solenoid Actuator Misaligned

- Adjust the position of the solenoid actuator.

Section 3: Glycol System

Description

The purpose of the glycol system is to inject a fixed amount of glycol into each sphere regardless of the drop rate. The major components of the system are the glycol tank and two glycol pump assemblies. Each glycol pump assembly consists of a pump arm, constant displacement pump, inlet check valve, outlet check valve, and an injection needle.



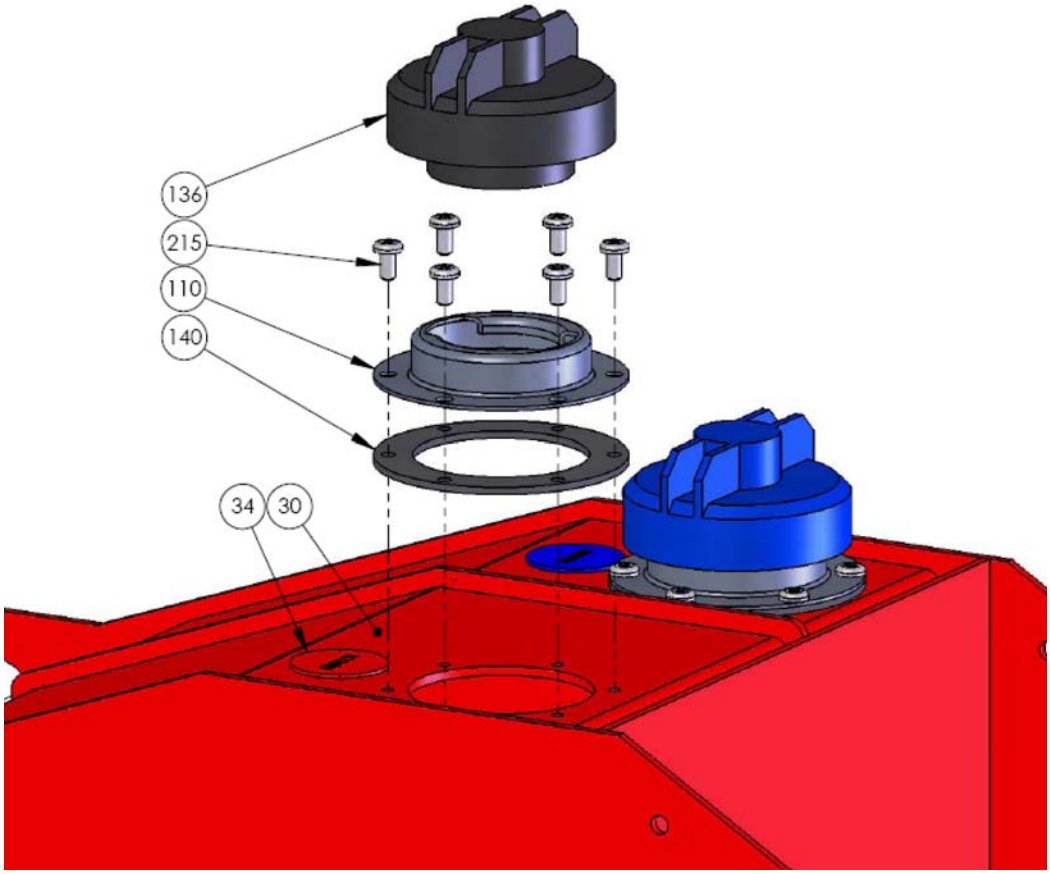
As the injection shuttle pushes a sphere towards the pump assembly, the tip of the injection needle pierces the sphere. Continued motion of the shuttle causes the sphere to press against the pump arm which compresses the piston. The inlet check valve is closed, preventing glycol from returning to the tank. As the fluid pressure in the pump cylinder rises, the outlet check valve opens, allowing the glycol in the pump cylinder to flow through the injection needle and into the sphere.

When the shuttle reverses direction, the sphere is pulled away from the pump arm, and an internal spring in the pump extends the piston. The outlet check valve is closed, preventing air from entering the cylinder through the needle. The extending piston creates a partial vacuum in the pump cylinder, and the atmospheric pressure in the glycol tank causes the inlet check valve to open, and the pump cylinder is refilled with glycol.

There are two filters in the glycol lines between the tank and the pump assemblies. They have clear outer bodies to allow visual inspection. The filters can be cleaned by removing and back flushing with water.

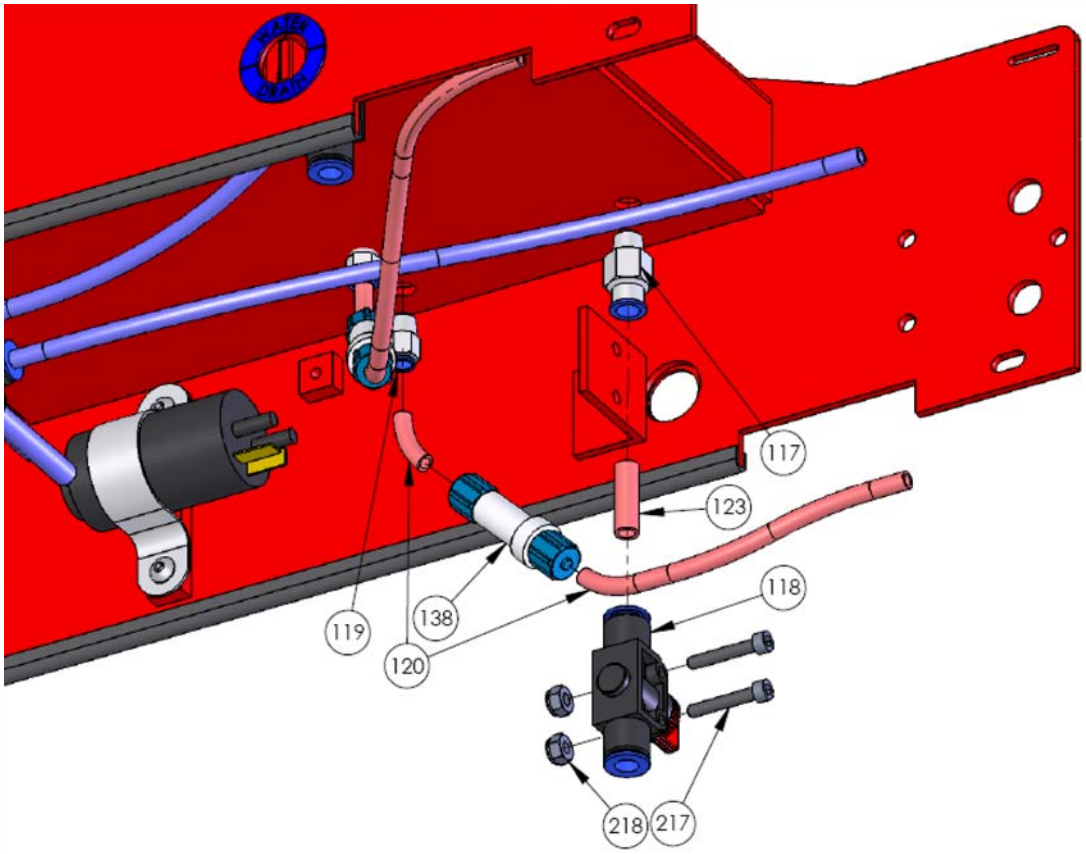
Glycol System Components

Glycol Tank



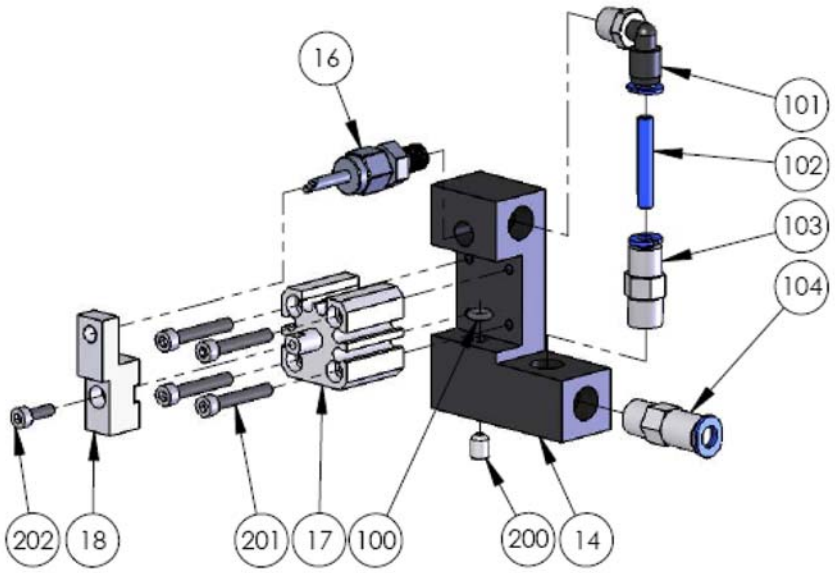
Item	Description	Part #	Qty
30	TANK	DE13410	1
34	TAG, GLYCOL CAP	DE13905	1
110	FILLER NECK	005997	1
136	GLYCOL CAP	005996	1
140	GASKET, FILLER NECK	006398	1
215	SEAL SCREW, SS, #10-32 X 3/8	000546	6

Glycol Piping



Item	Description	Part #	Qty
117	ADAPTER, 1/8 NPT x 8 MM	003651	1
118	DRAIN VALVE, 8 MM	004224	1
119	ADAPTER, 1/8 NPT x 6 MM	003650	2
120	TUBING, 6 MM, RED	004219	21.25 IN
123	TUBING, 8 MM, RED	004221	1.75 IN
138	GLYCOL FILTER	006324	2
217	SOCKET HEAD CAPSCREW, SS, # 8-32 x 1	000423	2
218	NYLOCK NUT, SS, # 8-32	001659	2

Glycol Pump



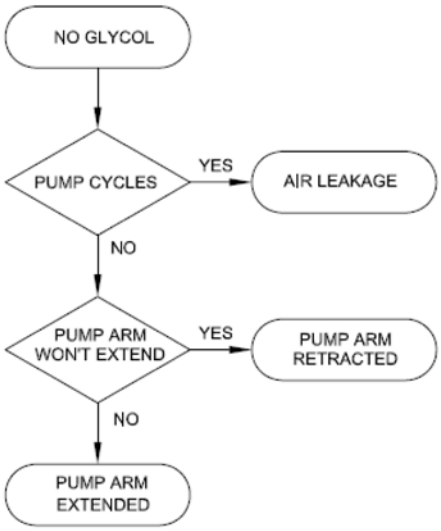
Item	Description	Part #	Qty
14	MANIFOLD BLOCK, LH / RH (LH SHOWN)	DE13225 / DE13226	1
16	INJECTION NEEDLE	DE13227	1
17	GLYCOL PUMP	DE13223	1
18	PUMP ARM	DE13228	1
100	O-RING, BUNA N, AS568A - 007	005112	1
101	STREET ELBOW, 1/8 NPT x 4 MM	003643	1
102	TUBING, 4 MM	004217	1 IN
103	OUTLET CHECK VALVE, 1/8 NPT x 4 MM	004228	1
104	INLET CHECK VALVE, 1/8 NPT x 6 MM	004230	1
200	SETSCREW, SS, # 10-32 x 1/4	000525	1
201	SOCKET HEAD CAPSCREW, SS, # 6-32 x 7/8	000414	4
202	SOCKET HEAD CAPSCREW, SS, M3.0 x 10	000328	1

Glycol System Troubleshooting

Overview

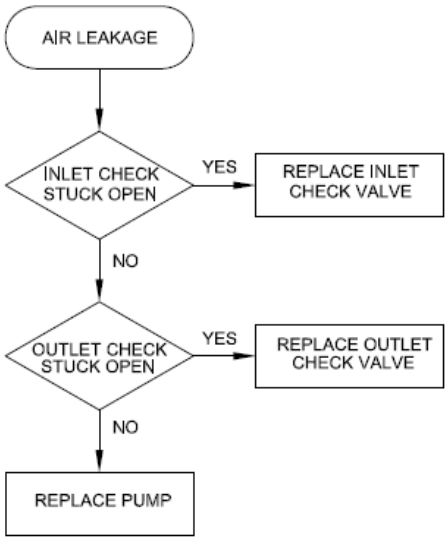
Prior to using this troubleshooting procedure, ensure that the basic troubleshooting outlined in the operator's manual has been performed. This advanced procedure assumes that there is glycol in the tank and that the user has attempted to prime the pump without success.

To diagnose the problem, cycle the glycol pump by squeezing and releasing the pump arm. Depending on the result, use the following flowchart to determine which subsection to use.



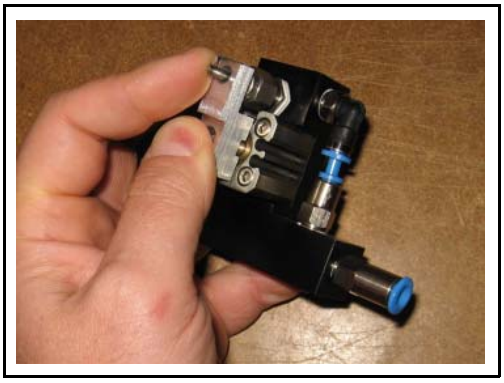
In each subsection is a secondary flowchart and detailed instructions to isolate the specific cause of the problem and determine a required action. Once the required action has been determined, the details of the repair procedure can be found in the repairs section.

Air Leakage



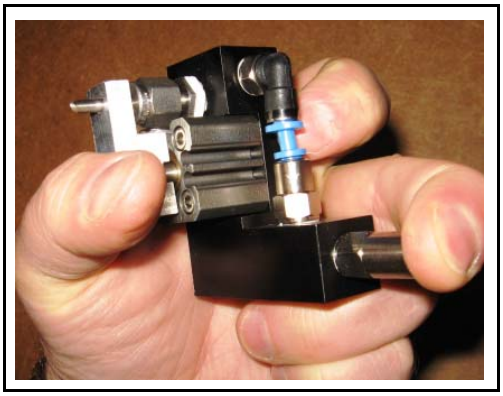
Inlet Check Valve Stuck Open

- Disconnect the glycol supply line to the inlet check valve and cap the line.
- Seal the end of the injection needle with your finger.
- Press the pump arm.
- If air or glycol flows from the inlet valve, repair or replace the inlet check valve.



Outlet Check Valve Stuck Open

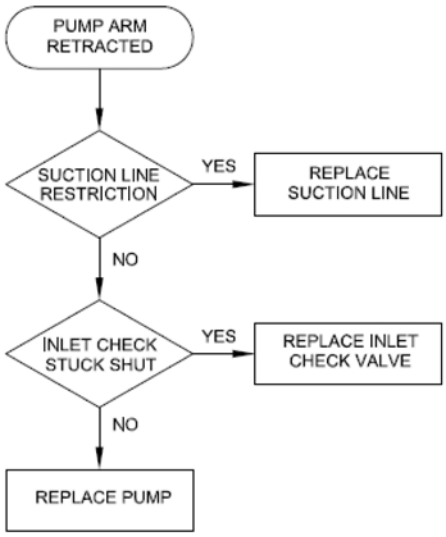
- Press and hold the pump arm
- Seal the inlet check valve using your finger.
- Release the pump arm.
- If the pump arm extends, repair or replace the outlet check valve.



Glycol Pump Damaged

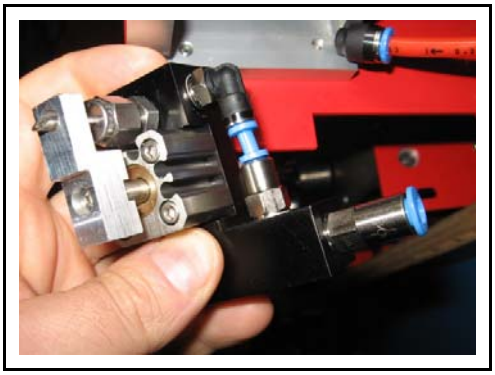
- Repair or replace the glycol pump.

Pump Arm Retracted



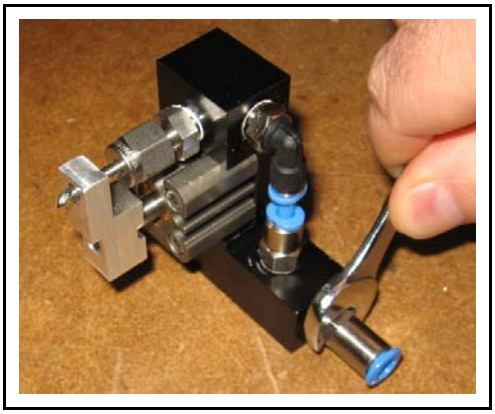
Suction Line Restriction

- Disconnect the glycol supply line to the inlet check valve.
- If the pump arm extends, repair or replace the suction line.
- Check glycol filters and clean as required.



Inlet Check Valve Stuck Shut

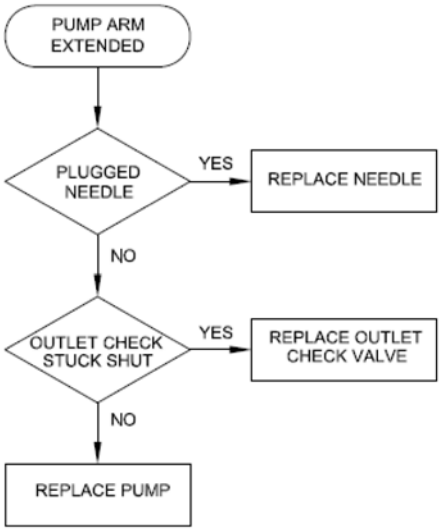
- Remove the inlet check valve from the manifold block.
- If the pump arm extends, repair or replace the inlet check valve.



Glycol Pump Damaged

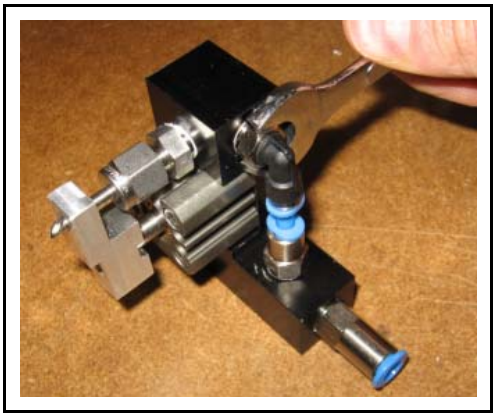
- Repair or replace the glycol pump.

Pump Arm Extended

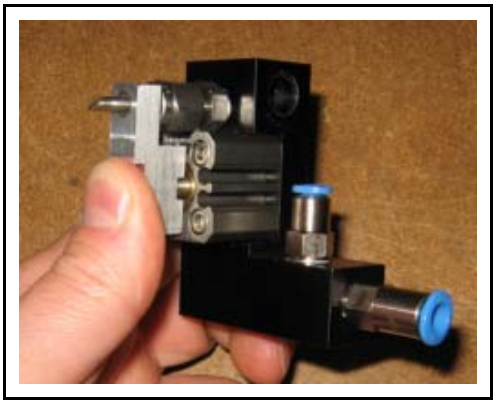


Plugged Injection Needle

- Un-thread the elbow from the manifold block.
- Remove elbow and tube from the outlet check valve.

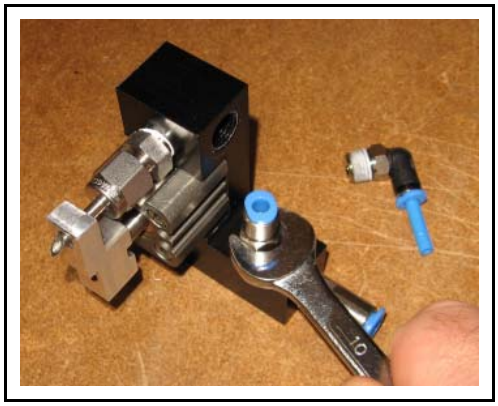


- Press the pump arm.
- If the pump arm compresses, repair or replace the injection needle

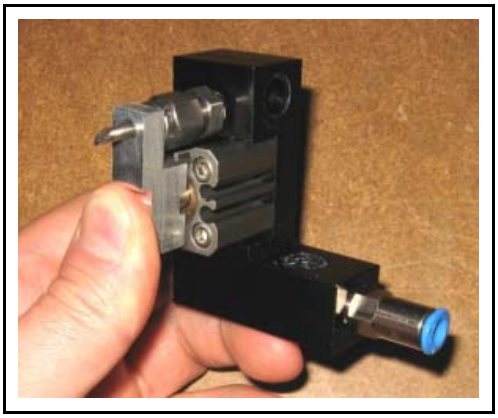


Outlet Check Valve Stuck Shut

- Un-thread the outlet check valve from the manifold block.



- Press the pump arm.
- If the pump arm compresses, repair or replace the outlet check valve.



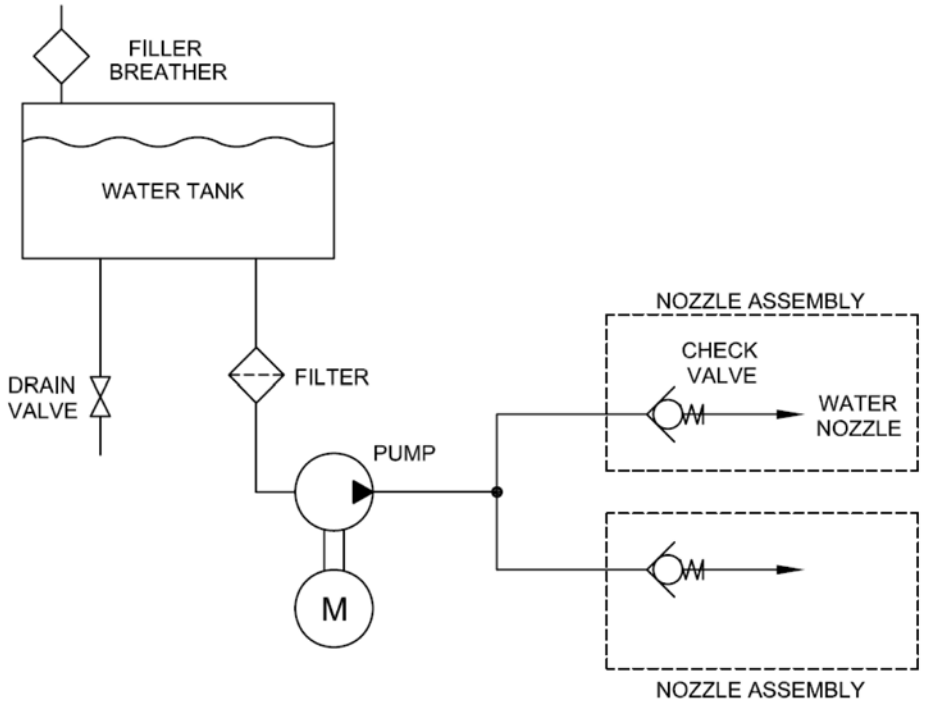
Glycol Pump Damaged

- Repair or replace the glycol pump.

Section 4: Water System

Description

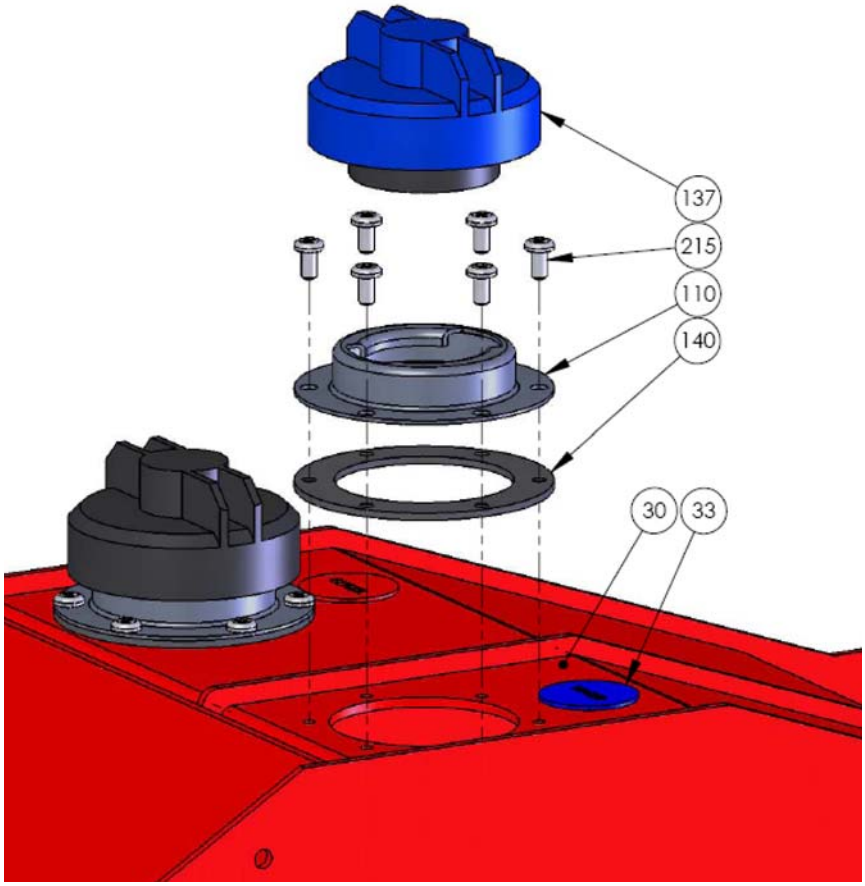
The purpose of the water system is to spray the injection chambers with water in the event of a sphere igniting in the chamber. The major components of the system are the water tank, pump, and two nozzle assemblies. Each nozzle assembly consists of a check valve and a water nozzle mounted into a block.



There is a filter in the water line between the tank and the pump. It has a clear outer body to allow visual inspection. The filter can be cleaned by removing and back flushing with water.

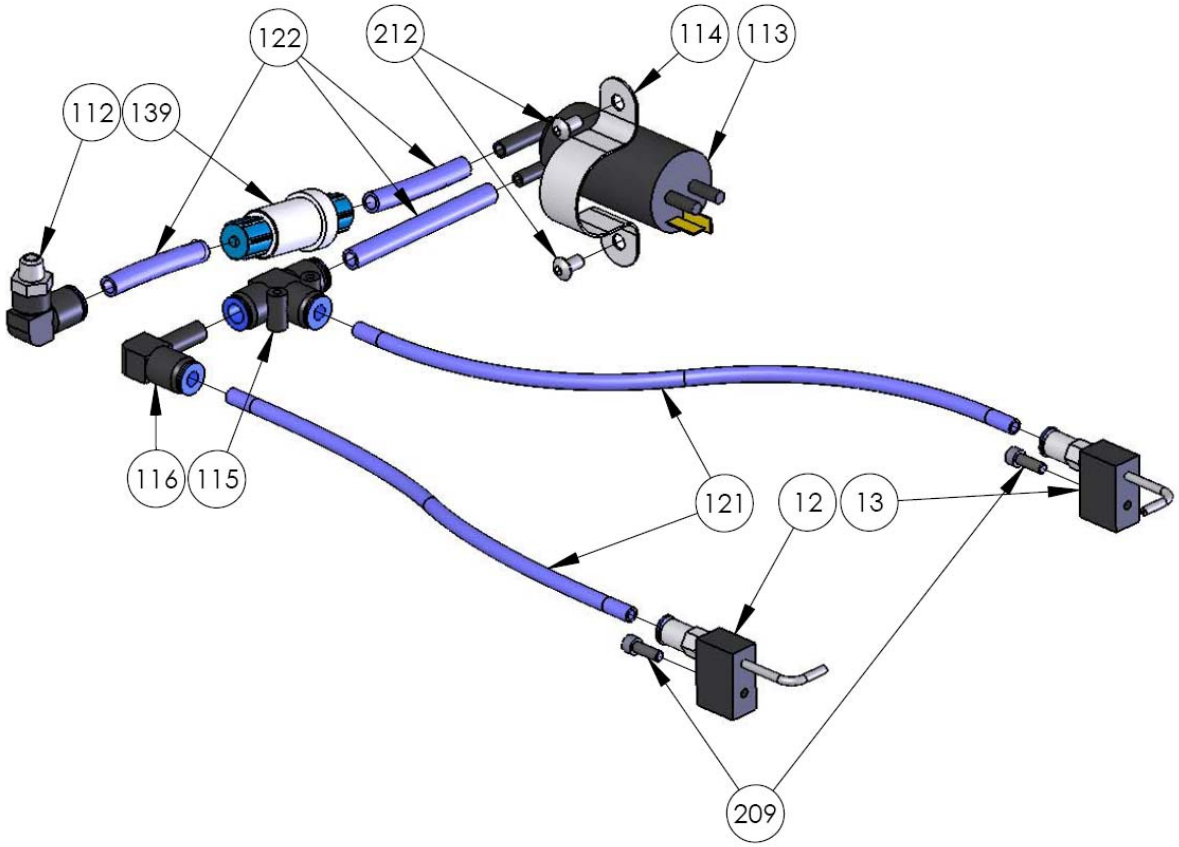
Water System Components

Water Tank



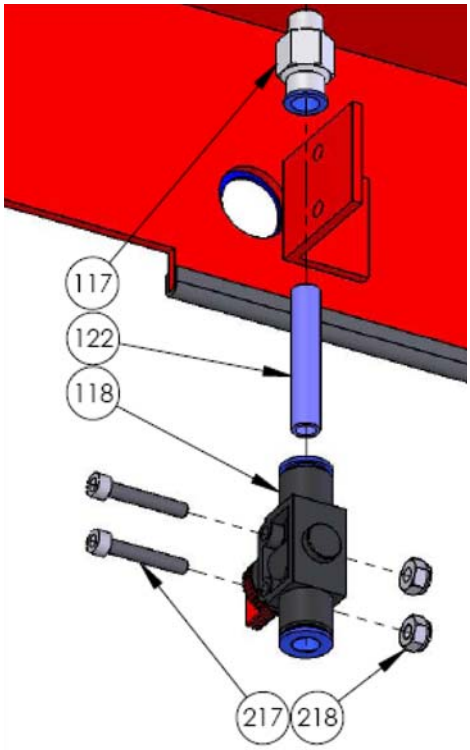
Item	Description	Part #	Qty
30	TANK	DE13410	1
34	TAG, WATER CAP	DE13904	1
110	FILLER NECK	005997	1
137	WATER CAP	005995	1
140	GASKET, FILLER NECK	006398	1
215	SEAL SCREW, SS, #10-32 X 3/8	000546	6

Water Piping



Item	Description	Part #	Qty
12	NOZZLE ASSY, LH	DE13218	1
13	NOZZLE ASSY, RH	DE13219	1
112	STREET ELBOW, 1/8 NPT x 8 MM	003649	1
113	WATER PUMP	006003	1
114	PUMP BRACKET	002982	1
115	TEE, 8 MM x 8 MM x 6 MM	003660	1
116	STREET ELBOW, 8 MM x 6 MM	003648	1
121	TUBING, 6 MM, BLUE	004218	24 IN
122	TUBING, 8 MM, BLUE	004220	10 IN
139	WATER FILTER	006236	1
209	SOCKET HEAD CAPSCREW, SS, # 8-32 X 1/2	000419	2
212	BUTTON HEAD CAPSCREW, SS, #10-24 x 3/8	000513	2

Water Drain Valve



Item	Description	Part #	Qty
117	ADAPTER, 1/8 NPT x 8 MM	003651	1
118	DRAIN VALVE, 8 MM	004224	1
122	TUBING, 8 MM, BLUE	004220	1.75 IN
217	SOCKET HEAD CAPSCREW, SS, #8-32 x 1	000423	2
218	NYLOCK NUT, SS, #8-32	001659	2

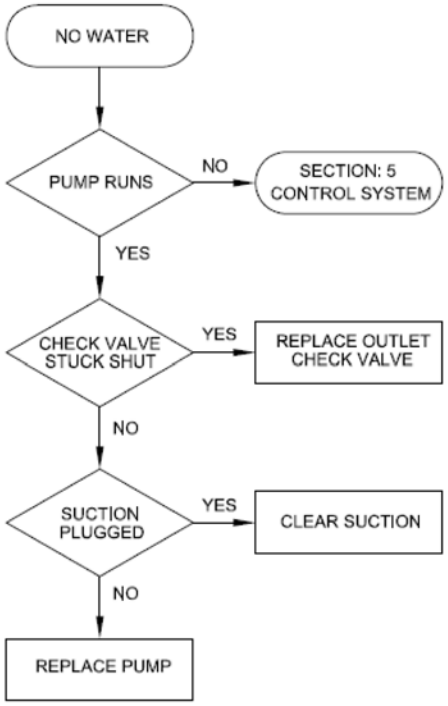
Water System Troubleshooting

Overview

Prior to using this troubleshooting procedure, ensure that the basic troubleshooting outlined in the operator's manual has been performed. This advanced procedure assumes that there is water in the tank.

Use the following flowchart and detailed instructions to isolate the specific cause of the problem and determine a required action. Once the required action has been determined, the details of the repair procedure can be found in the repairs section.

No Water

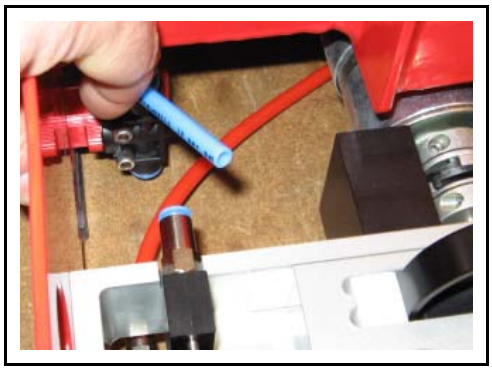


Control System

- Switch the water pump to the “ON” position momentarily.
- If the water pump does not run, see *Section 5: Control System*.

Check Valve Stuck Shut

- Disconnect one water discharge line from its nozzle check valve.
- Switch the water pump to the “ON” position momentarily.
- If water flows from the discharge line, replace the check valve.
- Repeat procedure for other check valve.



Suction Plugged

- Disconnect the pump suction line from the elbow in the bottom of the tank.
- If no water flows from the elbow, clean the tank suction.
- Check water filter and clean as required.

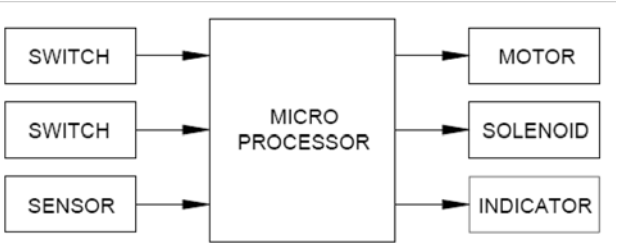
Water Pump Damaged

- Repair or replace the water pump.

Section 5: Control System

Control System Operation

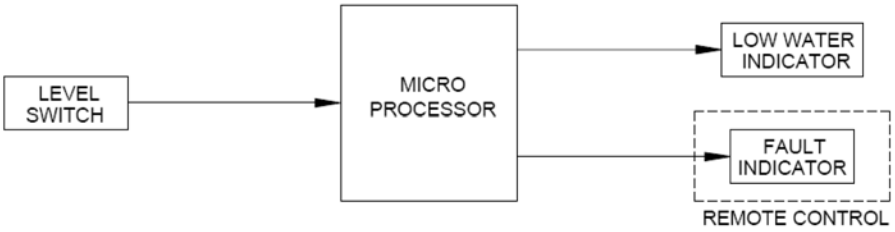
The control system for the Red Dragon is microprocessor based. Unlike conventional systems which have switches hard wired to specific devices, a microprocessor system has switches and sensors which provide input signals to a microprocessor. Based on these inputs, a software program makes decisions and sends signals to various output devices such as motors, solenoids, and indicators.



The advantage of this type of system is that it allows complex operation of the output devices. Any switch or sensor can be made to operate any output device based on the software program. It also allows the introduction of timing into the system. There can be delays and sequencing of output devices to make the dispenser function better. The details of the software program and system operation is quite complex and beyond the scope of this manual. However, the following sub sections explain the basic operation and interaction of the control system components.

Level Switch Operation

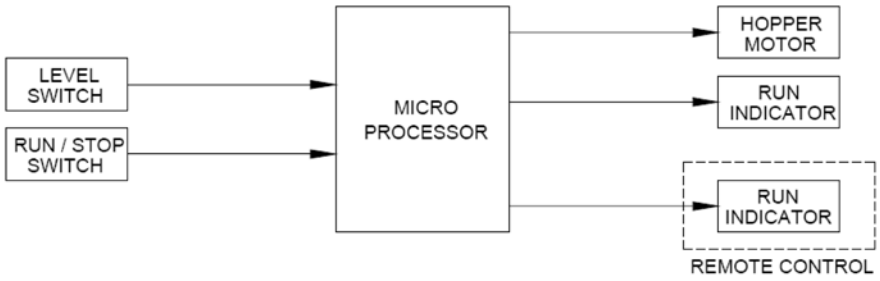
The water level switch is a float type switch located in the water tank. When the water level is low, the switch is open. The microprocessor illuminates the “LOW WATER” indicator, and flashes the “FAULT” indicator on the remote control. When the water level reaches the minimum required level, the switch closes, and the microprocessor extinguishes the “LOW WATER” and “FAULT” indicators. If the water level is low, the microprocessor ignores the input signal from the “RUN / STOP” switch.



This acts as an interlock to prevent operation of the dispenser when there is insufficient water in the reservoir. A faulty connection or broken wire will also produce an open circuit, preventing operation of the dispenser.

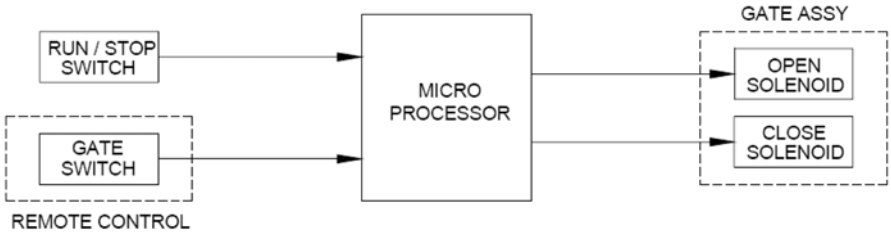
Hopper Operation

The hopper agitator is driven by a DC motor. When the "RUN / STOP" switch is set to the "RUN" position, the microprocessor checks the level switch to see if there is enough water to operate the dispenser. If the water level is adequate, a 24V signal is sent to the hopper motor. The microprocessor also illuminates the "RUN" indicators on the main control panel and on the remote control.



Gate Operation

The remote control provides the input signals to operate the feed gate solenoids. The open and close solenoids are used to change the position of the feed control rod and the feed gates.



When the "RUN / STOP" switch is in the "STOP" position, the inputs from the remote control are ignored. When it is switched to the "RUN" position, there is also a short delay before the remote control signals are acted upon. This is to ensure that the hopper has time to fill its outlet queues before the gates open.

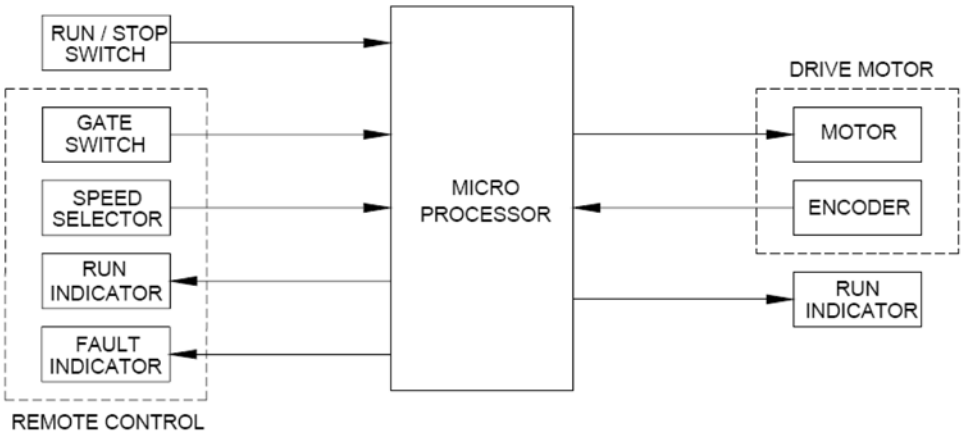
When the gate switch is pressed to the "OPEN" position, a signal is sent to energize the close solenoid. The close solenoid extends, pushing the feed control rod and takes the lateral pressure off the open solenoid pin. While the close solenoid holds the feed control rod in this position, a signal is sent to the open solenoid to retract the locking pin.

While the locking pin is retracted by the open solenoid, the close solenoid is de-energized, allowing the feed control rod to be driven open by the feed control spring. Finally the open solenoid is de-energized.

When the gate switch is pressed to the “CLOSE” position, a signal is sent to energize the close solenoid. The close solenoid extends, pushing the feed control rod and compressing the feed control spring. When the groove in the feed control rod aligns with the open solenoid locking pin, the spring loaded pin enters the groove and locks the gate shut. After a time delay, the close solenoid de-energizes.

Drive Motor Operation

The remote control also provides the input signals to operate the drive motor



When the “RUN / STOP” switch is in the “STOP” position, the inputs from the remote control are ignored and the drive motor will not run. When the gate switch is pressed to the “OPEN” position, a signal is sent to the gate solenoids to open the feed gates. After a short delay, a signal is then sent to turn on the drive motor.

This delay is to ensure that the first spheres have fallen cleanly into the injection shuttle before attempting to move the shuttle. The microprocessor also causes the “RUN” indicators on the main control panel and on the remote control to flash.

The motor speed is selected by a three bit, rotary encoder located on the remote control. Using only three signal wires, it sends a speed signal from one to seven which is decoded by the microprocessor to determine the desired motor speed. The drive motor is a DC motor operating on a closed loop control system.

When the microprocessor sends a power signal to the motor, the motor shaft rotates. On the rear of the motor is an encoder which measures the actual speed of the motor shaft and reports this back to the microprocessor.

The microprocessor compares the actual speed with the speed requested by the remote control and makes adjustments to the motor signal until the actual speed matches the requested speed. This adjustment process takes place continuously when the drive motor is running to ensure that it is at the correct speed. The motor signal is varied using a technique called pulse width modulation (PWM).

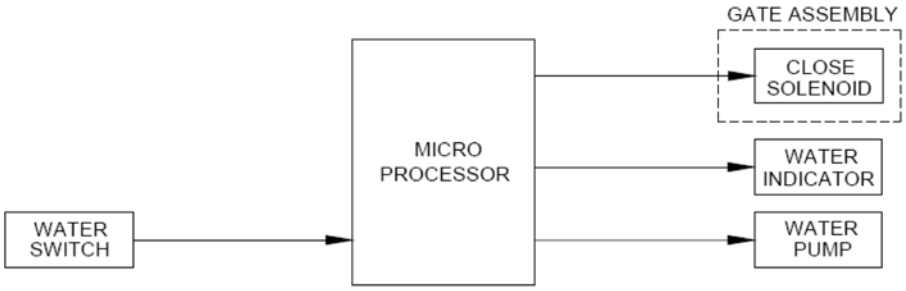
When the operator selects a faster speed, there will be a momentary imbalance between the desired speed and actual speed. The microprocessor sends an increased signal to the motor to cause it to speed up. The motor signal increases gradually over a fraction of a second so that the motor speed increases smoothly.

If the dispenser jams, the motor will stop turning and there will be a large difference between the desired speed and the actual speed. Initially, the microprocessor tries to increase the motor power to eliminate this error. However, if the speed error persists for more than a fixed amount of time, the microprocessor decides that the machine is jammed. The motor first reverses at a slow speed for a fixed time period and then resumes normal operation. During this operation, the "FAULT" indicator on the remote control will flash.

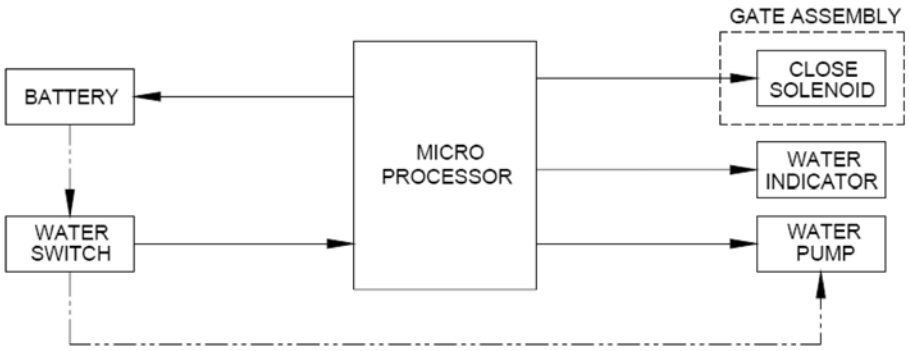
When the gate switch is pressed to the "CLOSE" position, the drive motor continues to run for three more revolutions to purge the remaining spheres in the injection head. To prevent the motor from acting like a generator when the manual hand wheel is turned, there is a motor isolation relay. When there is no power to the dispenser, the relay contacts are open, and the drive motor is isolated from the main control board. When power is supplied to the dispenser, the relay contacts close and connect the drive motor to the main control board.

Water Pump Operation

When the "WATER" switch is pressed, a 24VDC signal is sent operate the water pump. The microprocessor illuminates the "WATER" indicator on the main control panel. The microprocessor also sends a signal to the close solenoid to close the feed gates.

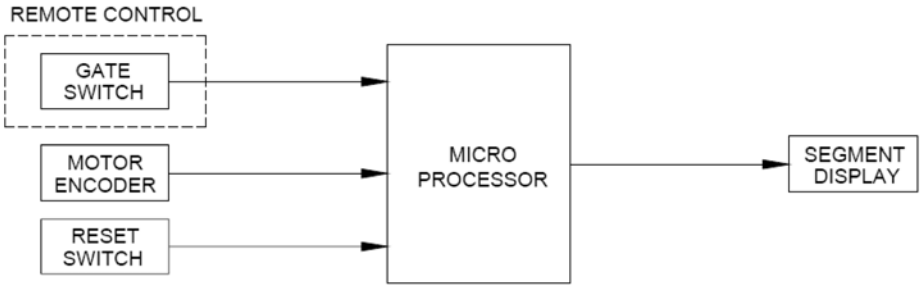


The dispenser is also equipped with a rechargeable battery. A built in charger system maintains charge on the battery whenever the unit is receiving power from an external power supply. When there is no external power supply, pressing the "WATER" switch connects the 12VDC emergency battery directly to the emergency water pump.



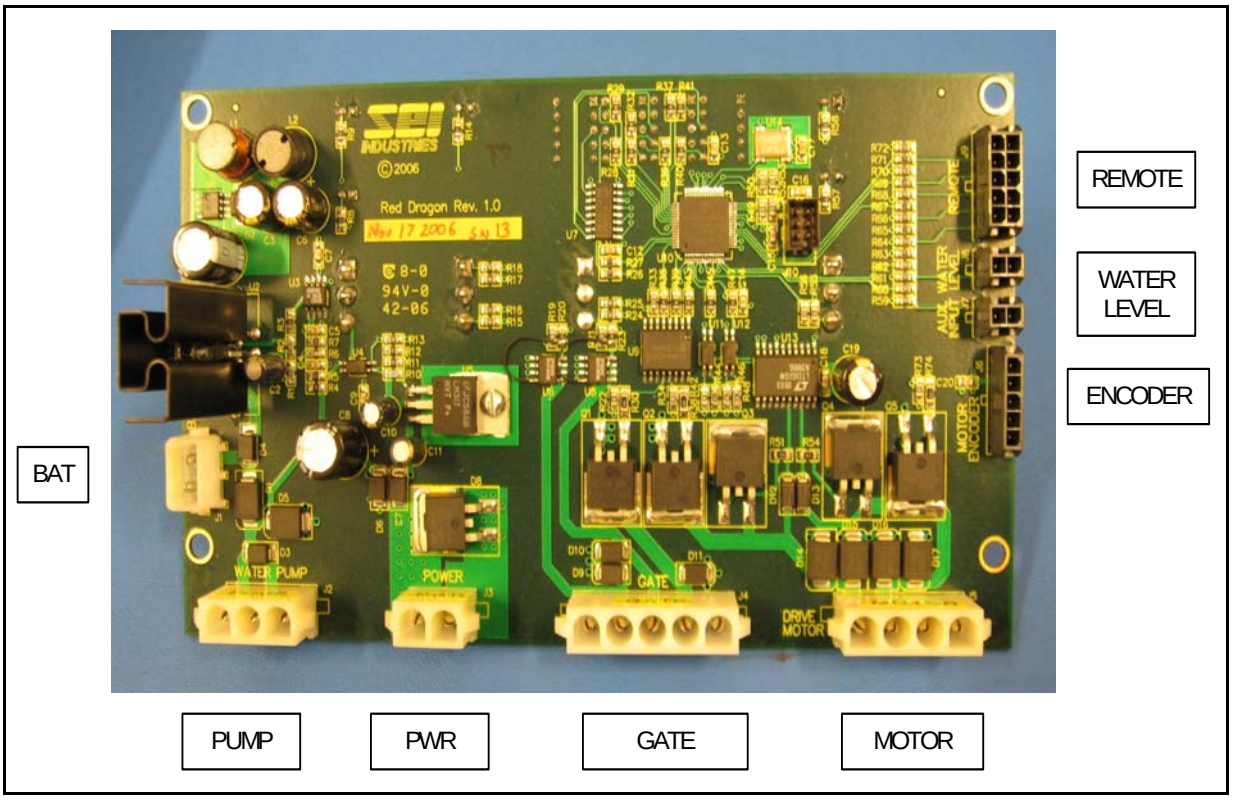
Sphere Counting

When the gate switch is pressed to the "OPEN" position, the microprocessor begins counting spheres based on motor revolutions. The count is displayed on the segmented LED display. When the gate switch is pressed to the "CLOSE" position, it stops counting spheres.

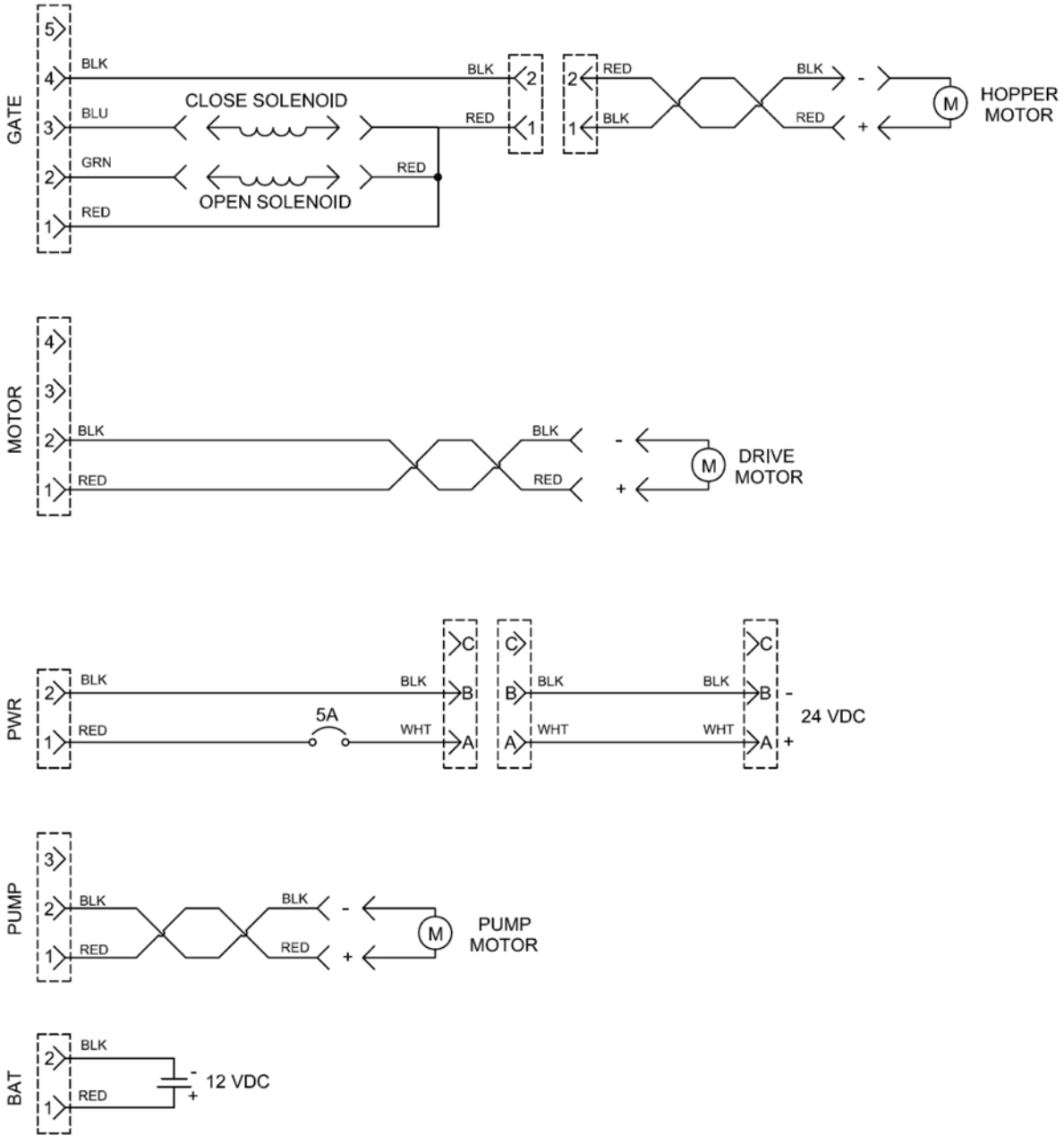


By pressing and holding the "COUNT RESET" switch, the sphere count can be reset to zero. By pressing the switch momentarily, the display can be toggled between normal display and a lifetime count of spheres indicated in thousands

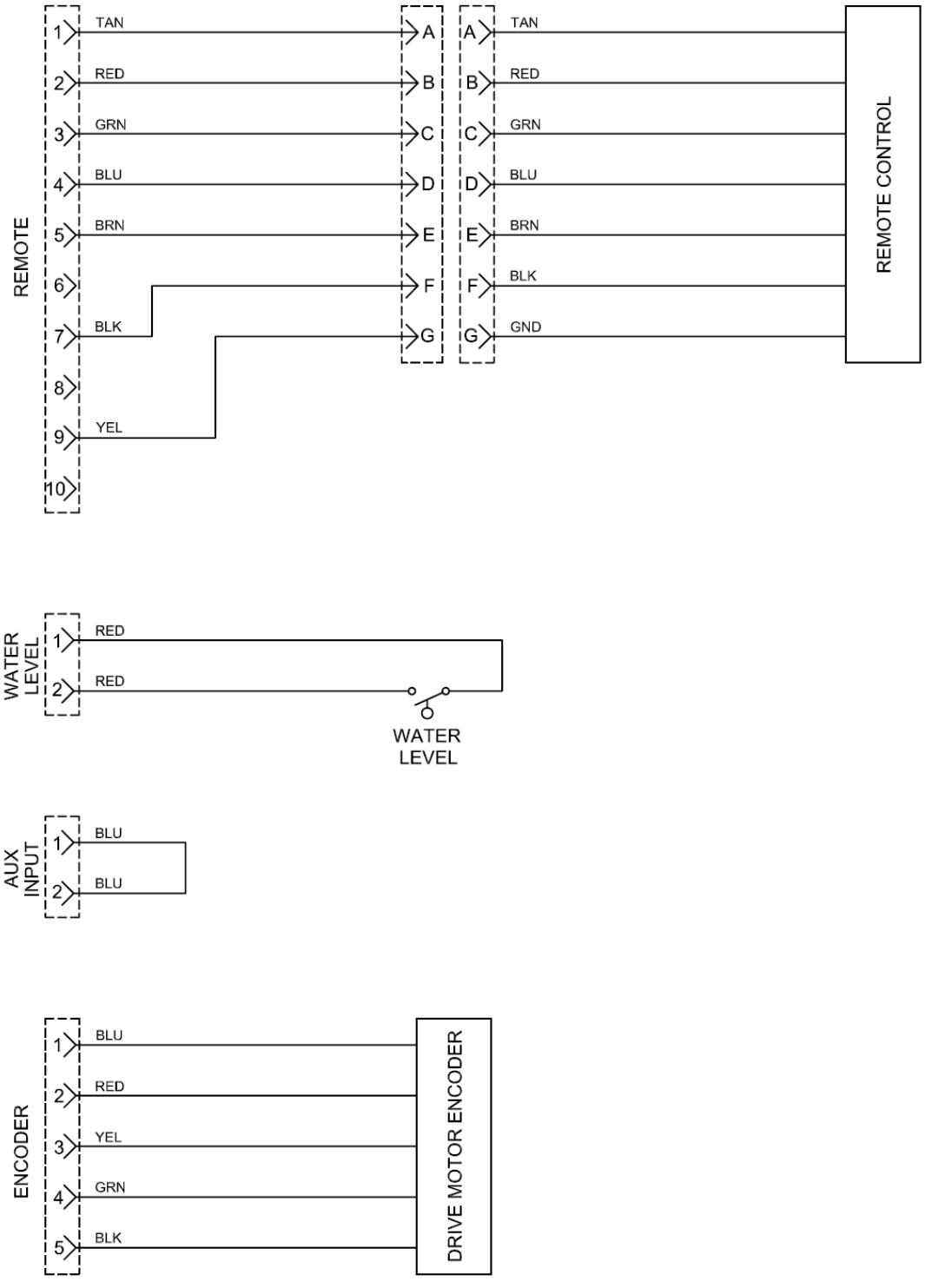
Main Control Board Layout



Wiring Diagrams

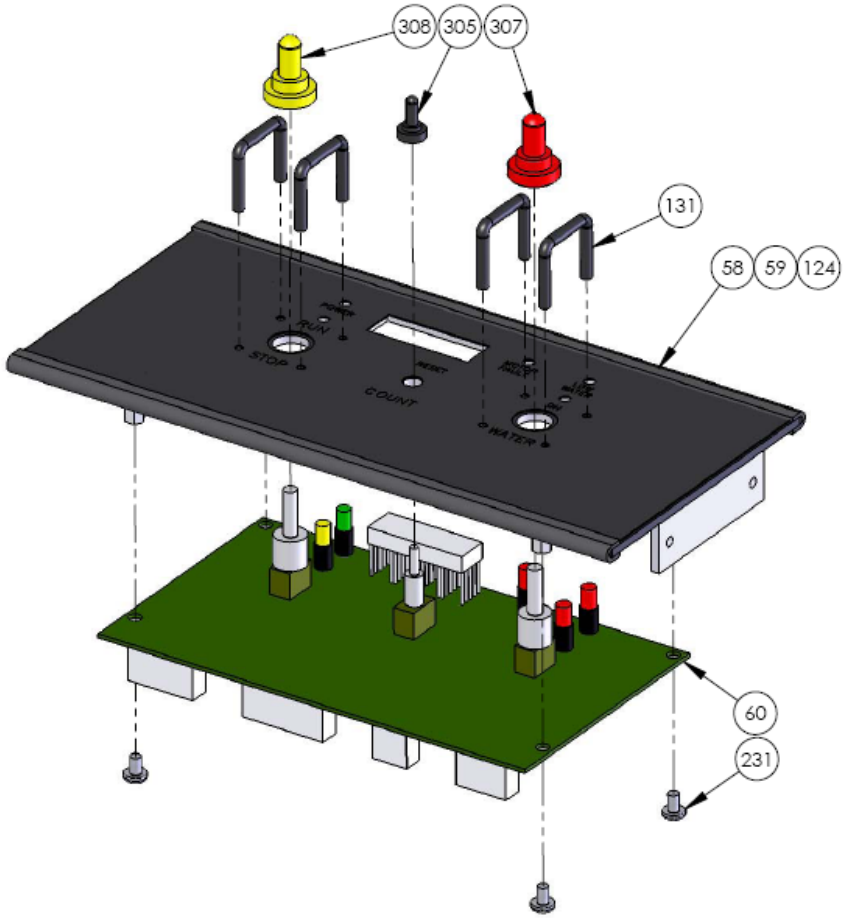


Wiring Diagrams (continued)



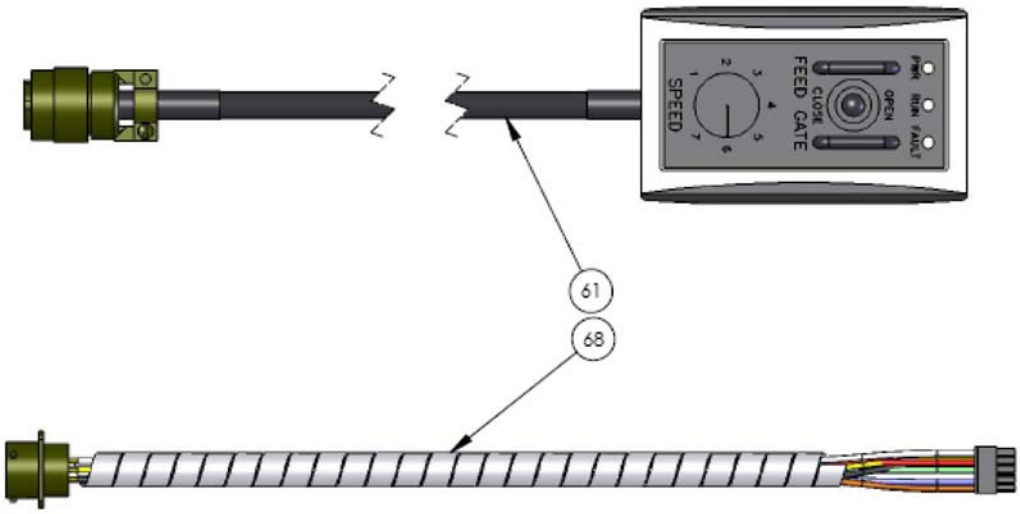
Control System Components

Main Control Panel



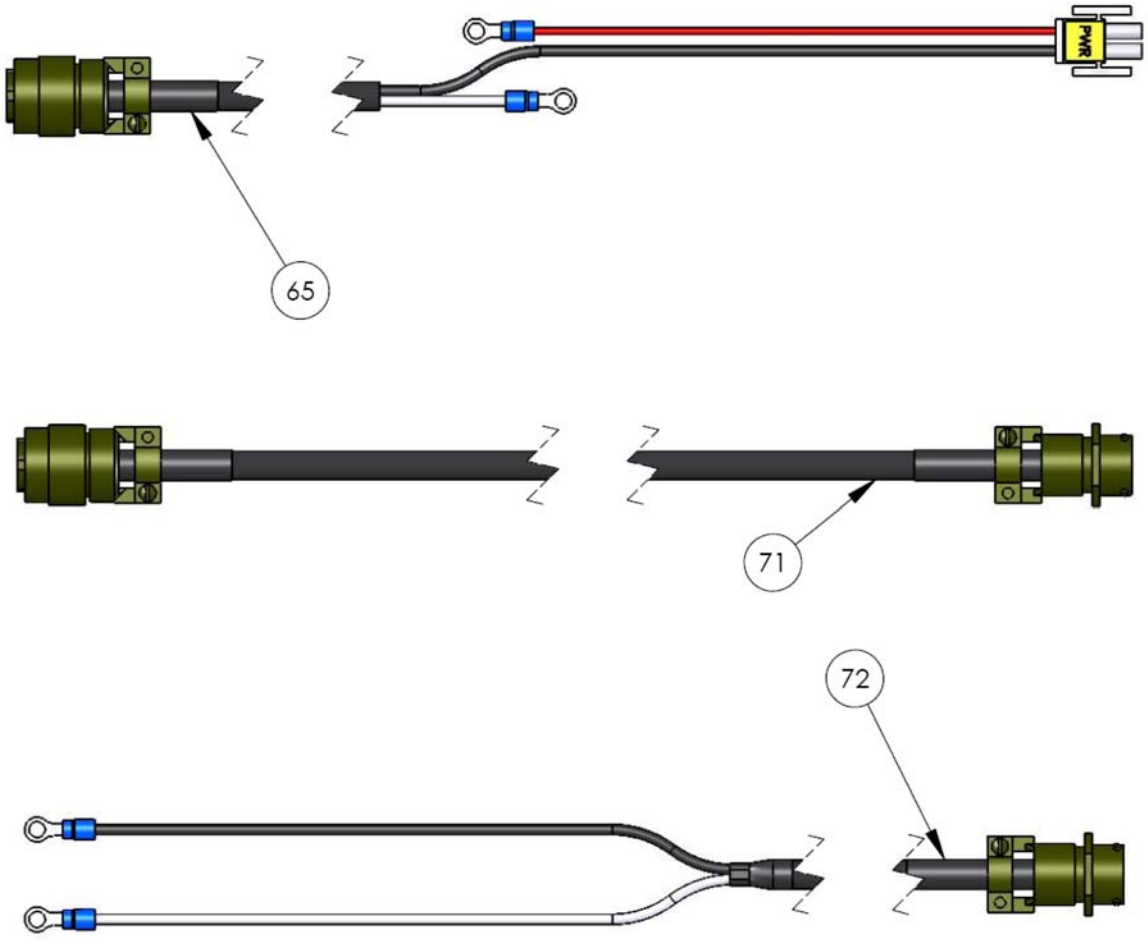
Item	Description	Part #	Qty
58	CONTROL PANEL	DE13601	1
59	CONTROL PANEL OVERLAY`	DE13604	1
60	MAIN CONTROL BOARD	DE13610	1
124	U CHANNEL, 1/8 X 1/4	003128	2
131	SWITCH GUARD, 1 X 1 X # 4-40	005139	4
231	MACHINE SCREW, PAN PHILLIPS, SS, # 8-32 X 1/4	000486	4
305	SWITCH BOOT, 1/4-40, BLACK	001364	1
307	SWITCH BOOT, M12, RED	001366	1
308	SWITCH BOOT, M12, YELLOW	001367	1

Remote Control



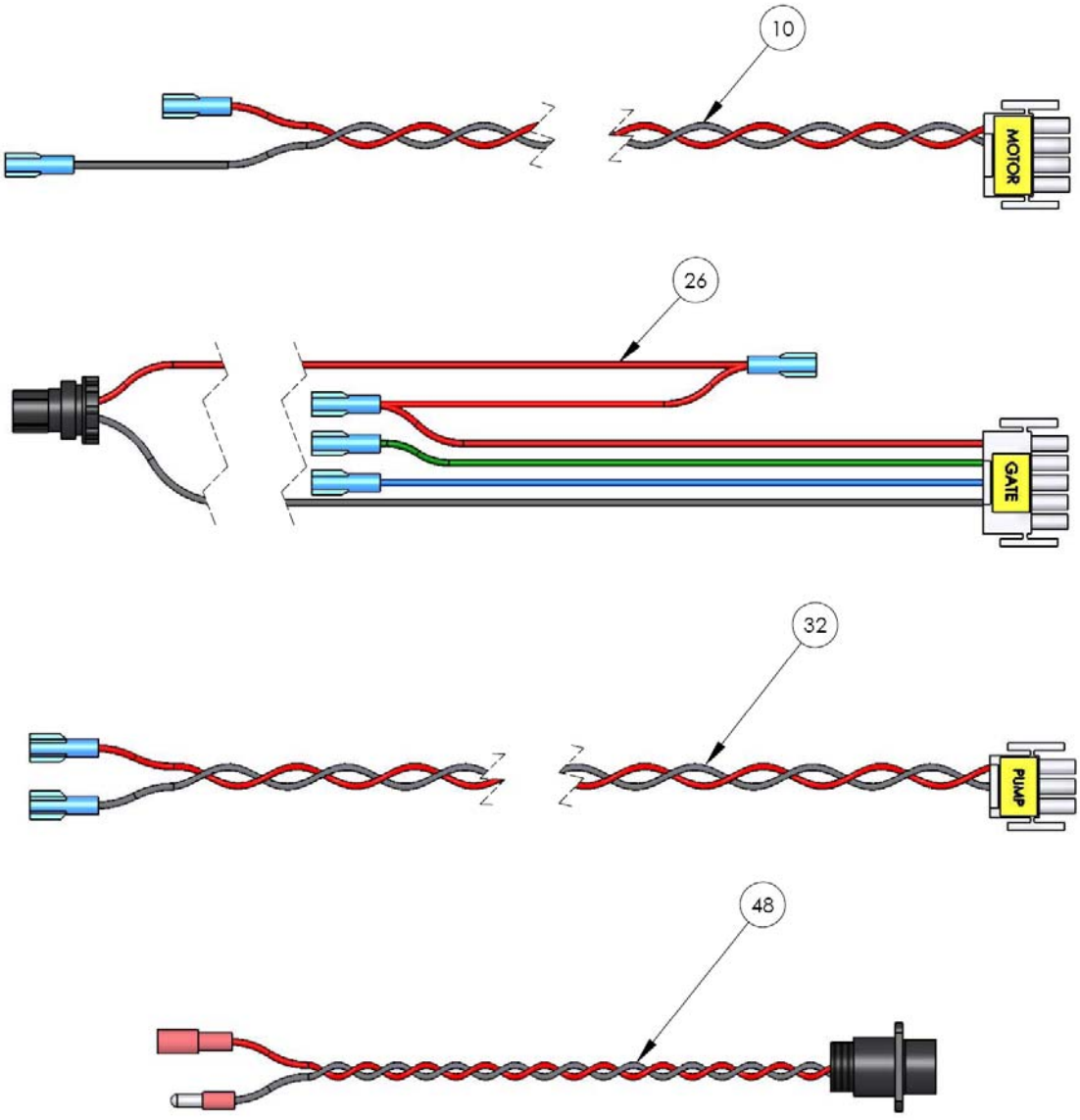
Item	Description	Part #	Qty
61	REMOTE CONTROL	DE13700	1
68	REMOTE CONTROL WIRING HARNESS	DE13910	1

Power Wiring



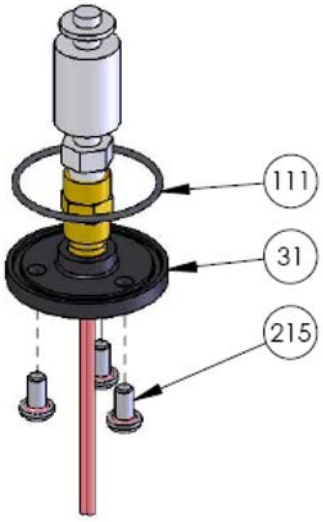
Item	Description	Part #	Qty
65	POWER WIRING HARNESS	DE13903	1
71	POWER CORD, MS3116F-12-3P	DE13950	1
72	POWER CORD, AUXILIARY	DE13960	1
300	CIRCUIT BREAKER, MS3320, 5A	000900	1

Wiring Harness



Item	Description	Part #	Qty
10	DRIVE MOTOR WIRING HARNESS	DE13212	1
26	GATE WIRING HARNESS	DE13307	1
32	PUMP WIRING HARNESS	DE13421	1
48	HOPPER MOTOR WIRING HARNESS	DE13518	1

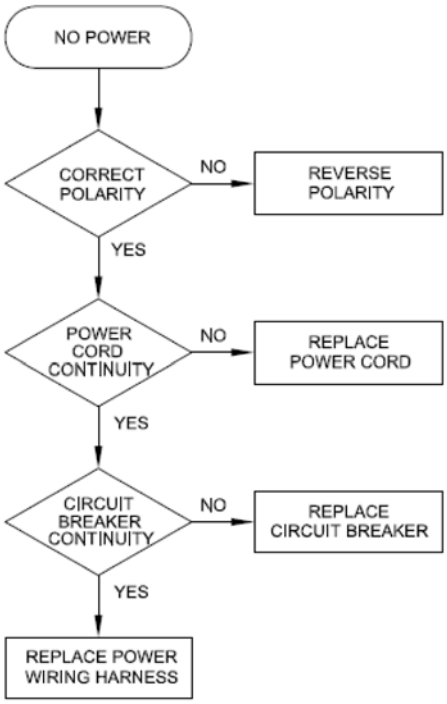
Water Level Switch



Item	Description	Part #	Qty
31	LEVEL SWITCH ASSY	DE13421	1
111	O-RING, BUNA N, AS568A - 029	005993	1
215	SEAL BOLT, SS, #10-32 X 3/8	000546	3

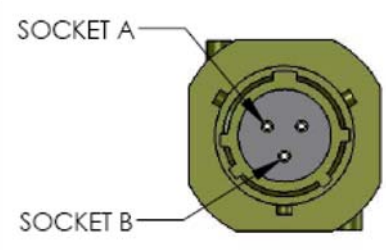
Control System Troubleshooting

No Power



Power Supply Polarity

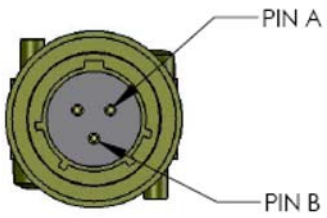
- Disconnect the power cord from the pigtail cord on the front of the dispenser.



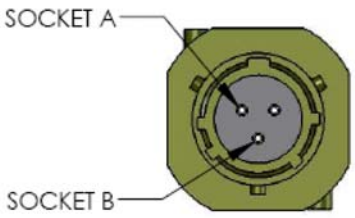
- Place the positive probe of a voltmeter into socket “A” of the power cord receptacle.
- Place the negative probe into socket “B” of the power cord receptacle.
- Measure the supply voltage. If the voltage measurement is negative, reverse the polarity of the power supply.

Power Cord Damaged

- Disconnect the power cord from the external power supply.
- Check continuity between pin “A” and socket “A” on the power cord. If there is no continuity, replace the main power cord.
- Check continuity between pin “B” and socket “B” on the power cord. If there is no continuity, replace the main power cord.



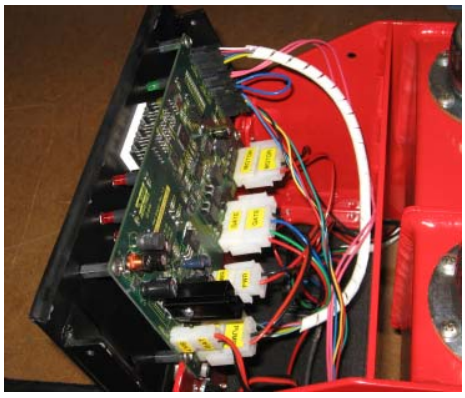
PLUG



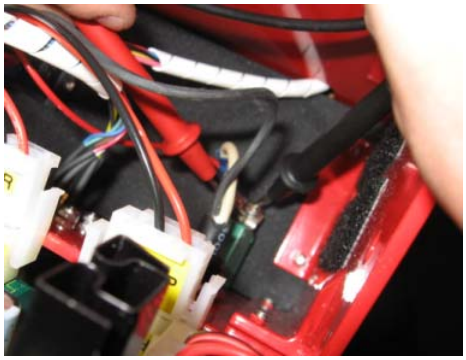
RECEPTACLE

Circuit Breaker Damaged

- Remove the four #10-24 x 3/8 button head capscrews which secure the control panel to the tank assembly.
- Tilt the control panel forwards to access the main circuit breaker.
- Remove the emergency battery.



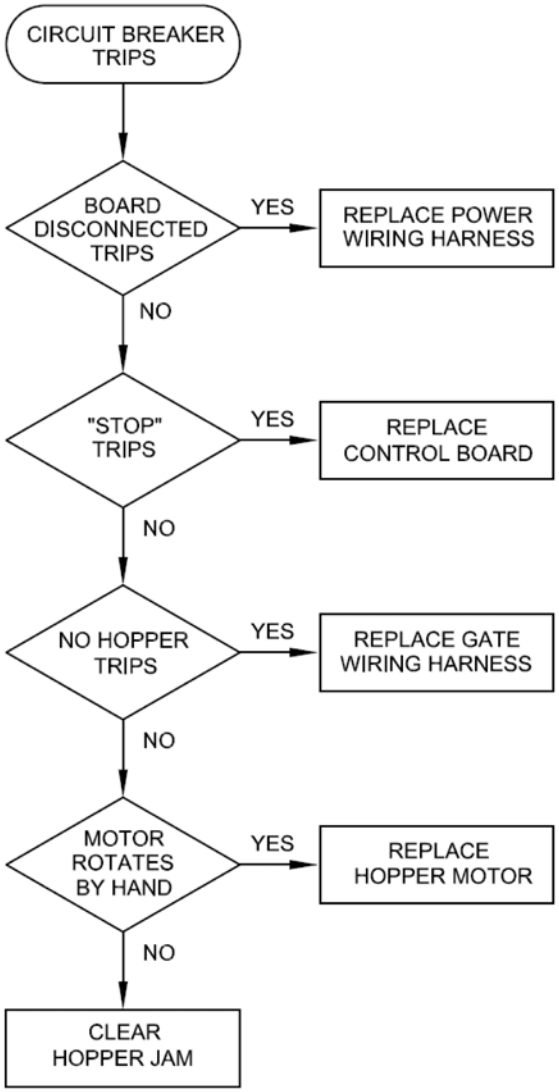
- Check that the main circuit breaker is pushed in.
- Check the continuity across the two terminals of the main circuit breaker.
- If there is no continuity, replace the main circuit breaker.



Power Wiring Harness Damaged

- Replace the power wiring harness.

Main Circuit Breaker Trips



Power Wiring Harness Damaged

- Remove the four # 10-24 x 3/8 button head capscrews which secure the control panel to the tank assembly.
- Tilt the control panel forwards to access the main control board.
- Disconnect the power wiring harness from the main control board.
- Reset the breaker.
- If the breaker trips replace the power wiring harness.

Main Control Board Damaged

- Switch the “RUN / STOP” switch to the “STOP” position.
- Reconnect the “PWR” wiring harness to the main control board.
- If the breaker trips, replace the main control board.

Gate Wiring Harness Damaged

- Remove the hopper from the gate assembly.
- Switch the “RUN / STOP” switch to the “RUN” position.
- If the breaker trips replace the gate wiring harness.

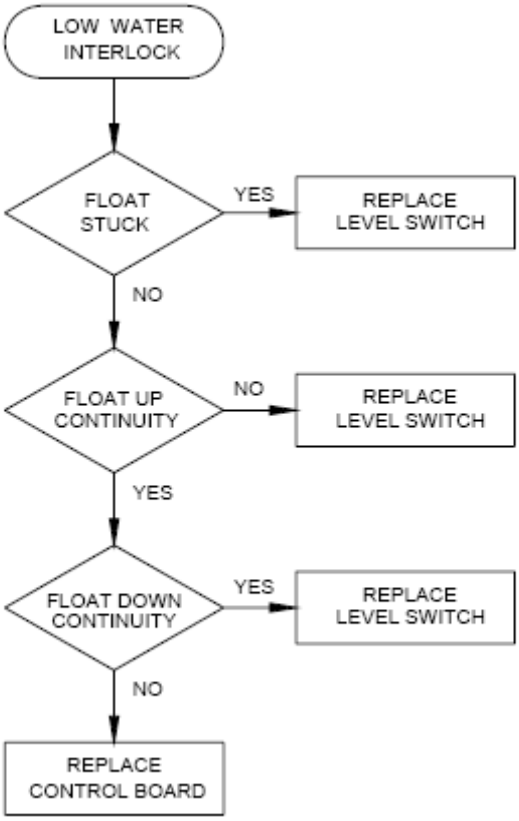
Hopper Motor Damaged

- Rotate the agitator cam and hopper motor by hand.
- If the motor rotates, replace the hopper motor.

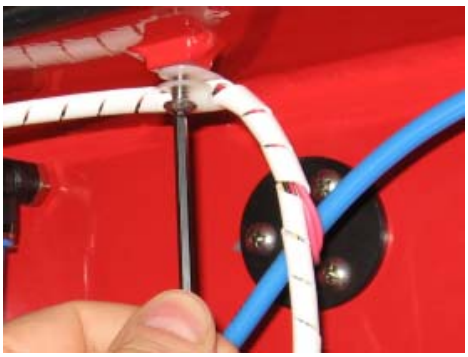
Hopper Jammed

- Clear the jam in the hopper agitator.

Low Water Interlock Not Functioning

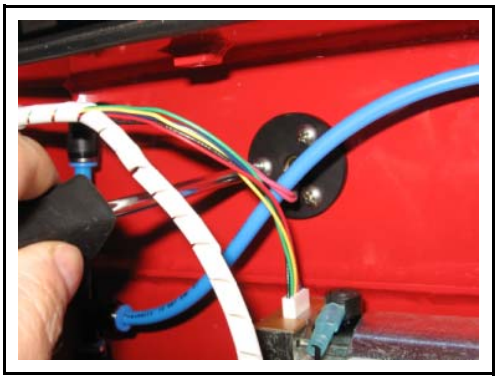


Level Switch Damaged



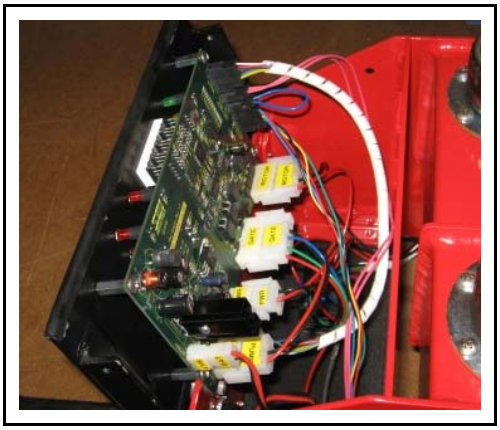
- Disconnect the power cord from any external power source.
- Drain the water tank.
- Drain the glycol tank.
- Remove # 10-32 x 3/8 button head capscrew that secures the P-clip to the tank.
- Unwrap approximately 4” of spiral wrap from the wires.

- Remove the three # 10-32 x 3/8 seal screws that secure the level switch into the tank.

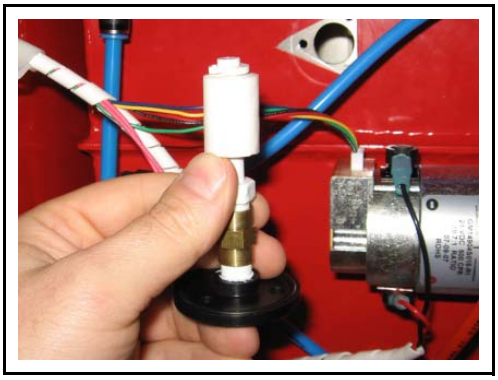


- Remove the level switch and O-ring from the tank.
- Check the level switch float for freedom of motion.
- If float is stuck, replace the level switch

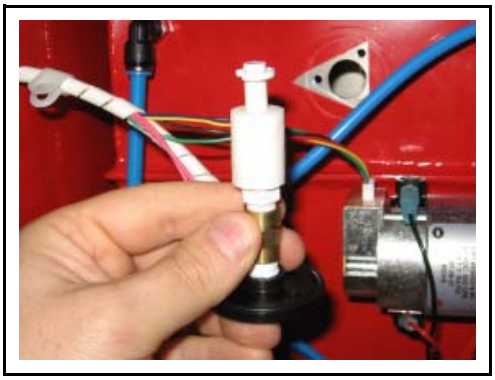
- Remove the four #10-24 x 3/8 button head capscrews which secure the control panel to the tank assembly.
- Tilt the control panel forwards to access the main control board.



- Unplug the level switch from the main control board.
- Check continuity across the two pins of the float switch plug when the float is at the top of the stem.
- If there is no continuity, replace the level switch



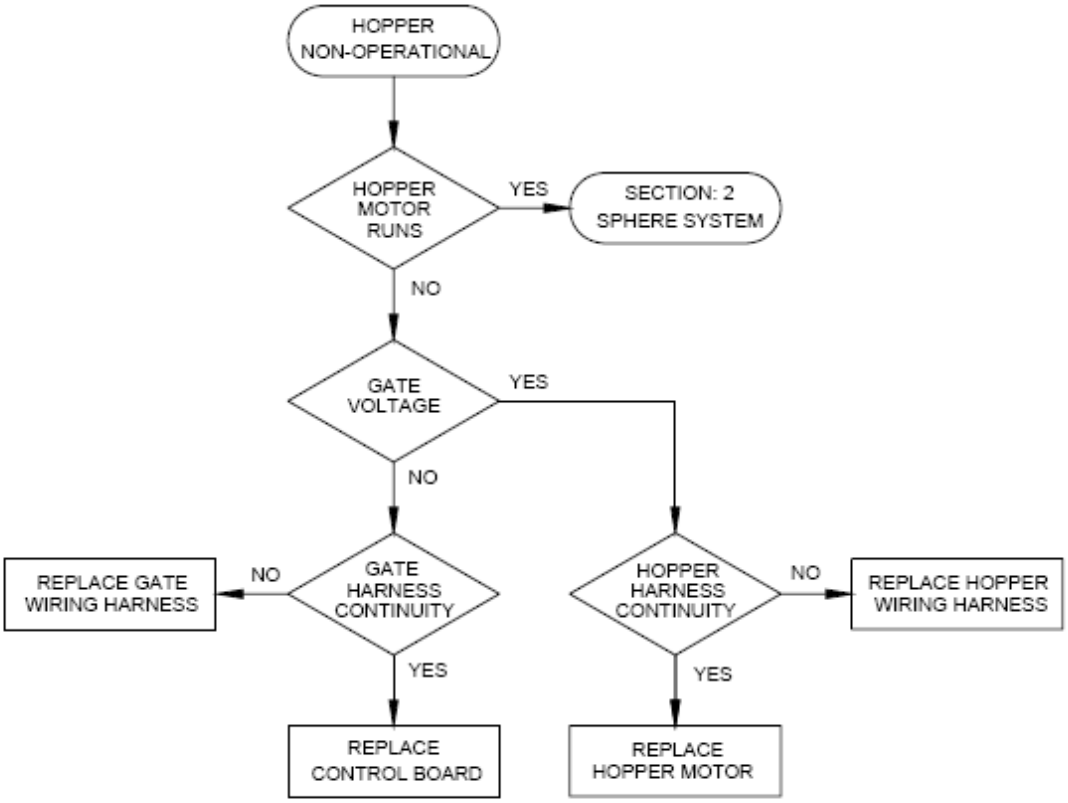
- Check continuity across the two pins of the float switch plug when the float is at the bottom of the stem.
- If there is continuity, replace the level switch.



Control Board Damaged

- Replace the main control board.

Hopper Agitator Non-Operational

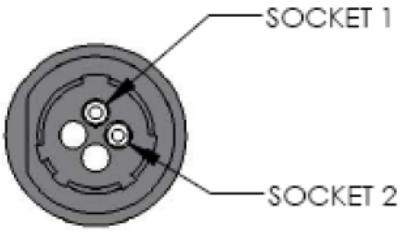


Sphere Handling System

- Set the “RUN / STOP” switch to “RUN.”
- If the hopper motor runs, go to *Section 2: Sphere Handling System*

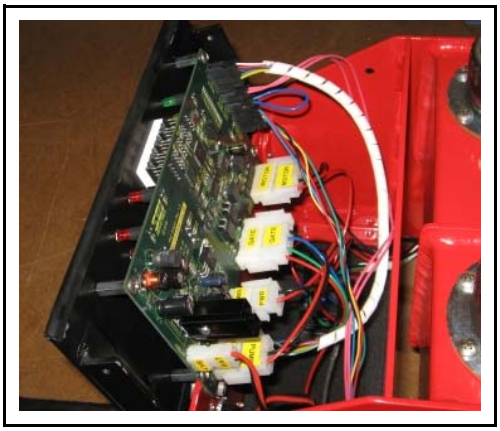
Gate Voltage

- Remove the hopper from the gate assembly.
- Measure the voltage across socket “1” and socket “2” of the gate receptacle (see below).
- If the voltage is equal to the supply voltage go to subsection *Hopper Wiring Harness Damaged.*

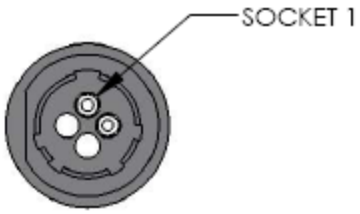


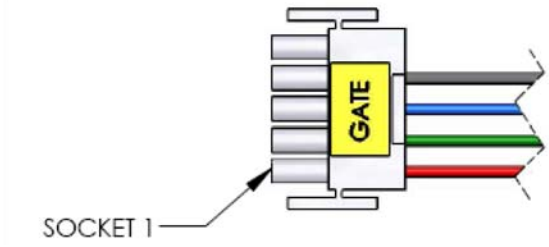
Gate Wiring Harness Damaged

- Disconnect the power cord from the external power supply.
- Remove the four #10-24 x 3/8 button head capscrews which secure the control panel to the tank assembly.
- Tilt the control panel forwards to access the main control board.

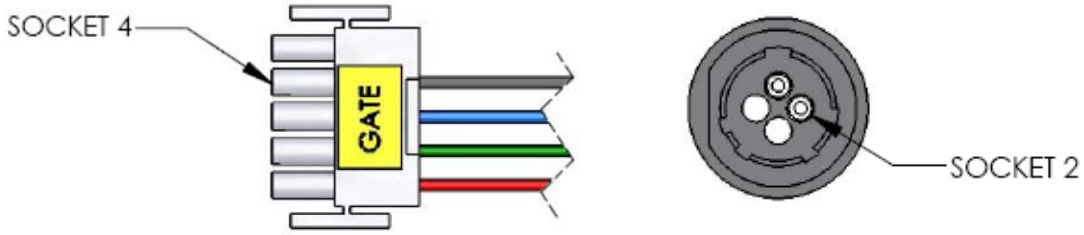


- Disconnect the gate wiring harness plug from the main control board.
- Check the continuity between socket “1” on the gate wiring harness plug and socket “1” on the gate receptacle.
- If there is no continuity, replace the gate wiring harness.





- Check the continuity between socket “4” on the gate wiring harness plug and socket “2” on the gate receptacle.
- If there is no continuity, replace the gate wiring harness.



Control Board Damaged

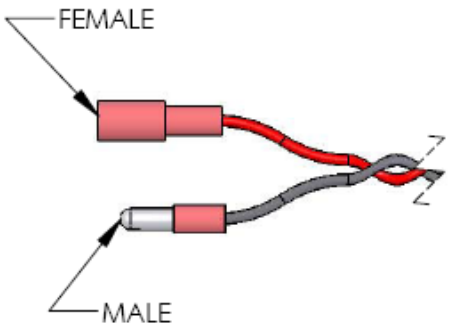
- Replace the main control board

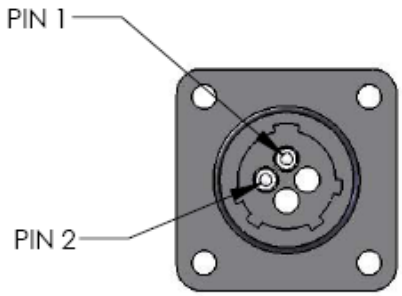
Hopper Wiring Harness Damaged

- Remove the four #10-24 x 3/8 button head capscrews which secure the agitator assembly to the hopper body.

- Remove the agitator assembly.
- Disconnect the bullet connectors which connect the hopper wiring harness to the hopper motor.

- Check the continuity between the male bullet connector and pin “1”
- If there is no continuity, replace the hopper wiring harness.
- Check the continuity between the female bullet connector and pin “2”
- If there is no continuity, replace the hopper wiring harness.

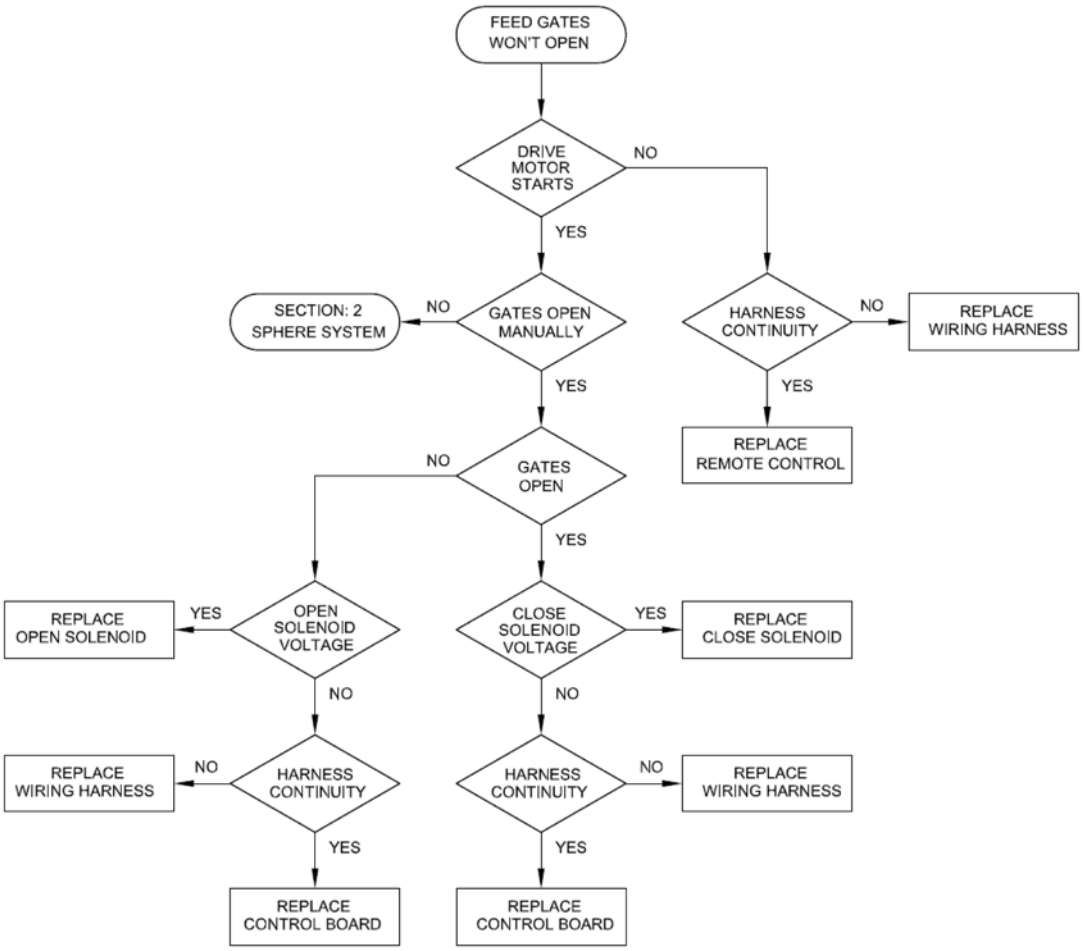




Hopper Motor Damaged

- Replace the hopper motor.

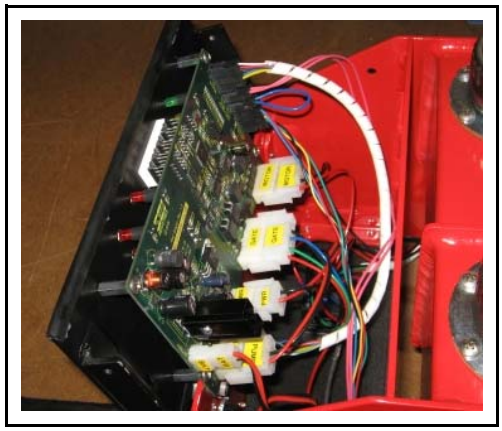
Feed Gates Won't Open



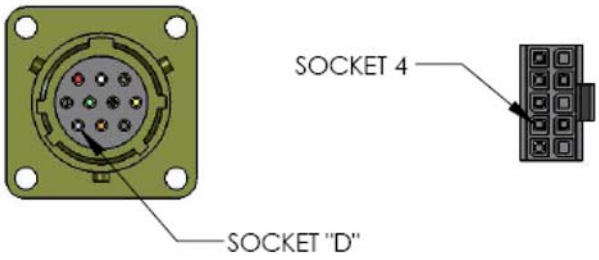
- Activate the open switch on the remote control.
- If the drive motor starts, go to subsection *Gates Open Manually.*

Remote Wiring Harness Damaged

- Disconnect the external power supply to the dispenser.
- Disconnect the remote control plug from the receptacle on the front of the dispenser.
- Remove the four #10-24 x 3/8 button head capscrews which secure the control panel to the tank assembly.
- Tilt the control panel forwards to access the main control board.



- Disconnect the remote wiring harness plug from the main control board.
- Check the continuity between socket “D” on the panel receptacle and socket “4” on the wiring harness plug.
- If there is no continuity, replace the remote wiring harness.

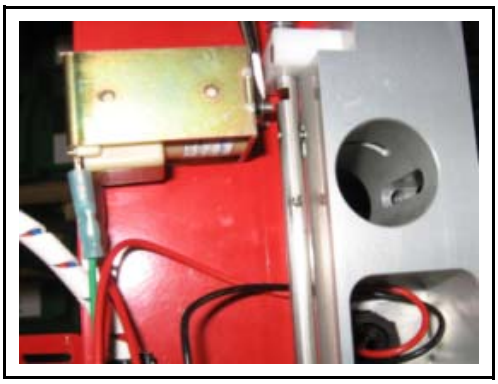


- Check the continuity between socket “F” on the panel receptacle and socket “7” on the wiring harness plug.
- If there is no continuity, replace the remote wiring harness.

Remote Control Damaged

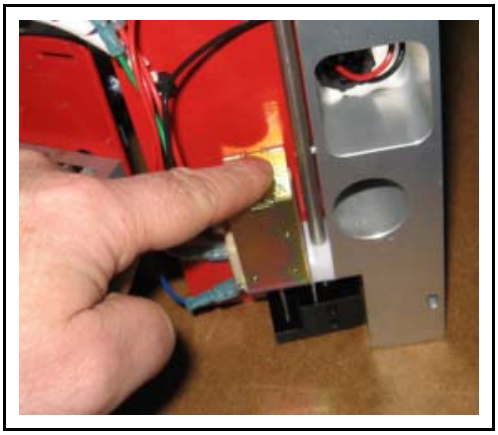
- Replace the remote control.

Gates Open Manually

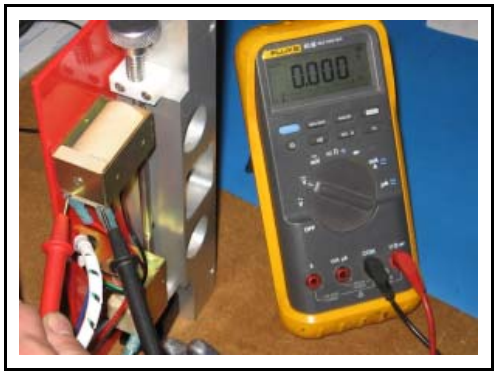


- Ensure that the drive motor is stopped.
- Remove the gate assembly.
- Use a screwdriver to lift the locking pin and unlock the feed control rod.
- If the gates do not open go to *Section 2: Sphere Handling System*

Open Solenoid Damaged

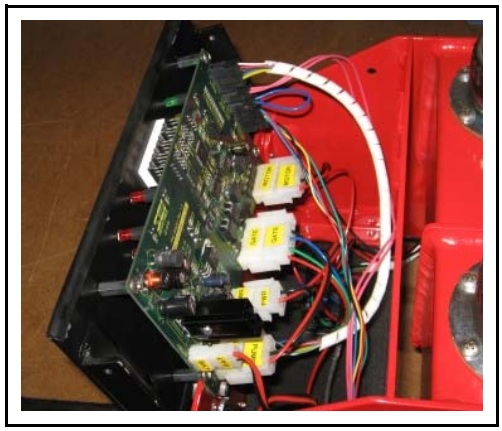


- Press on the close solenoid core to try to relieve the pressure on the lock pin.
- Activate the open switch on the remote control
- If the gates open go to subsection *Close Solenoid Damaged.*



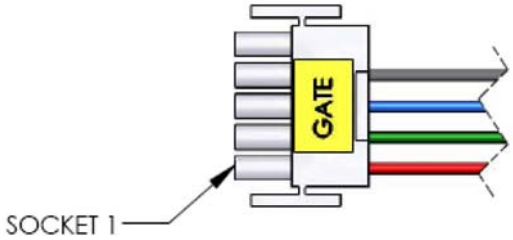
- Activate the close switch on the remote control and wait until the drive motor stops.
- Measure the voltage across the open solenoid terminals while activating the open switch on the remote control.
- If there is a transient voltage increase, replace the open solenoid

Gate Wiring Harness Damaged

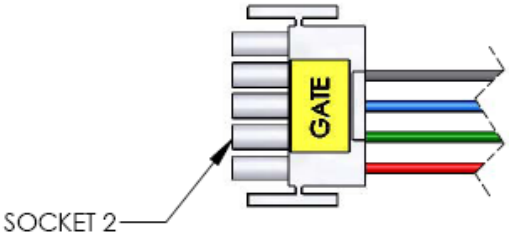


- Disconnect the external power supply to the dispenser.
- Remove the four #10-24 x 3/8 button head capscrews which secure the control panel to the tank assembly.
- Tilt the control panel forwards to access the main control board.

- Disconnect the gate wiring harness plug from the main control board.
- Check the continuity between socket “1” on the harness plug and the red wire on the open solenoid.
- If there is no continuity, replace the gate wiring harness.



- Check the continuity between socket “2” on the harness plug and the green wire on the open solenoid.
- If there is no continuity, replace the gate wiring harness



Control Board Damaged

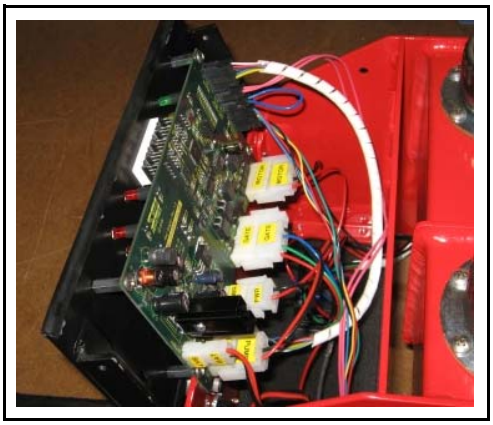
- Replace the main control board.

Close Solenoid Damaged

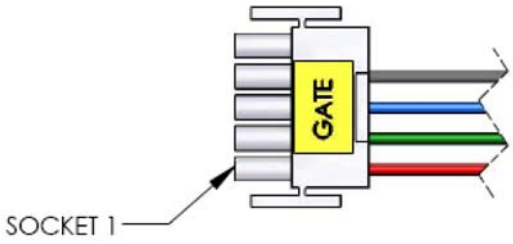
- Activate the close switch on the remote control and wait until the drive motor stops.
- Measure the voltage across the close solenoid terminals while activating the open switch on the remote control.
- If there is a transient voltage increase, replace the close solenoid.

Gate Wiring Harness Damaged

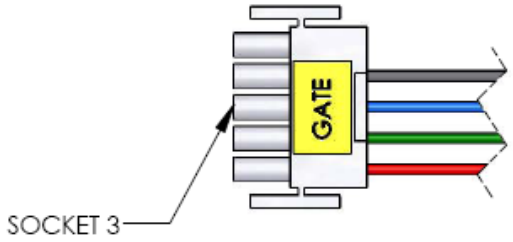
- Disconnect the external power supply to the dispenser.
- Remove the four #10-24 x 3/8 button head capscrews which secure the control panel to the tank assembly.
- Tilt the control panel forwards to access the main control board.



- Disconnect the gate wiring harness plug from the main control board.
- Check the continuity between socket “1” on the harness plug and the red wire on the open solenoid.
- If there is no continuity, replace the gate wiring harness.



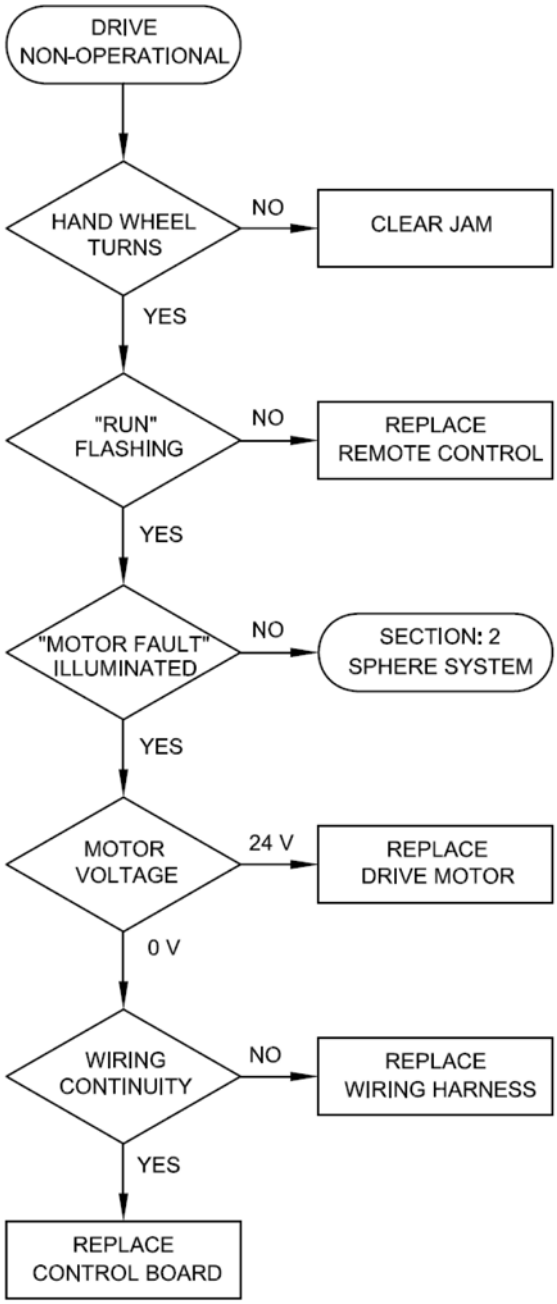
- Check the continuity between socket “3” on the harness plug and the green wire on the open solenoid.
- If there is no continuity, replace the gate wiring harness.



Control Board Damaged

- Replace the main control board.

Drive Mechanism Non-Operational



Hand Wheel Turns

- Remove the gate assembly.
- Rotate the manual hand wheel.
- If the hand wheel does not turn, clear the jam.

Remote Control Damaged

- If the “RUN” indicator on the main control panel is not flashing, replace the remote control.

Control System

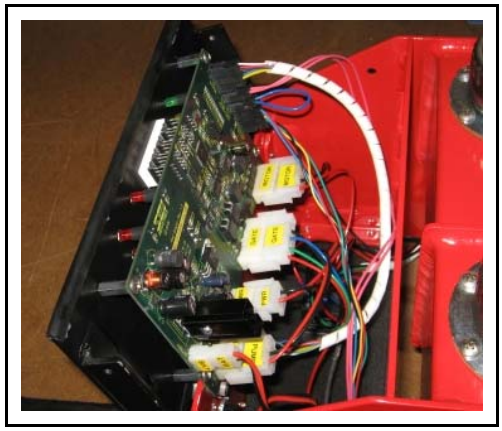
- If the “MOTOR FAULT” indicator on the main control panel is not illuminated, go to *Section 2: Sphere Handling System.*

Drive Motor Damaged

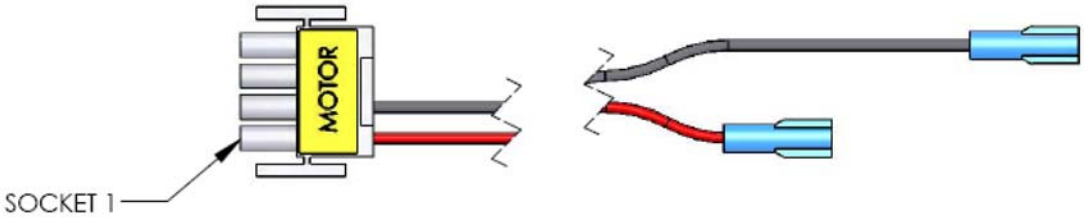
- Measure the voltage across the drive motor terminals.
- If the voltage is approximately equal to the supply voltage (24V), replace the drive motor.

Motor Wiring Harness Damaged

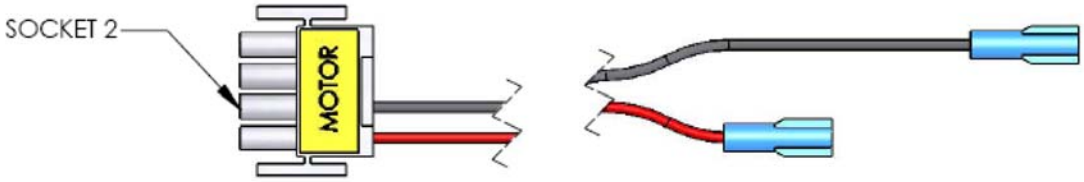
- Remove the four #10-24 x 3/8 button head capscrews which secure the control panel to the tank assembly.
- Tilt the control panel forwards to access the main control board.
- Unplug the motor wiring harness from the main control board.



- Measure the continuity between the red motor lead and socket # 1 on the harness plug.
- If there is no continuity, replace the wiring harness.



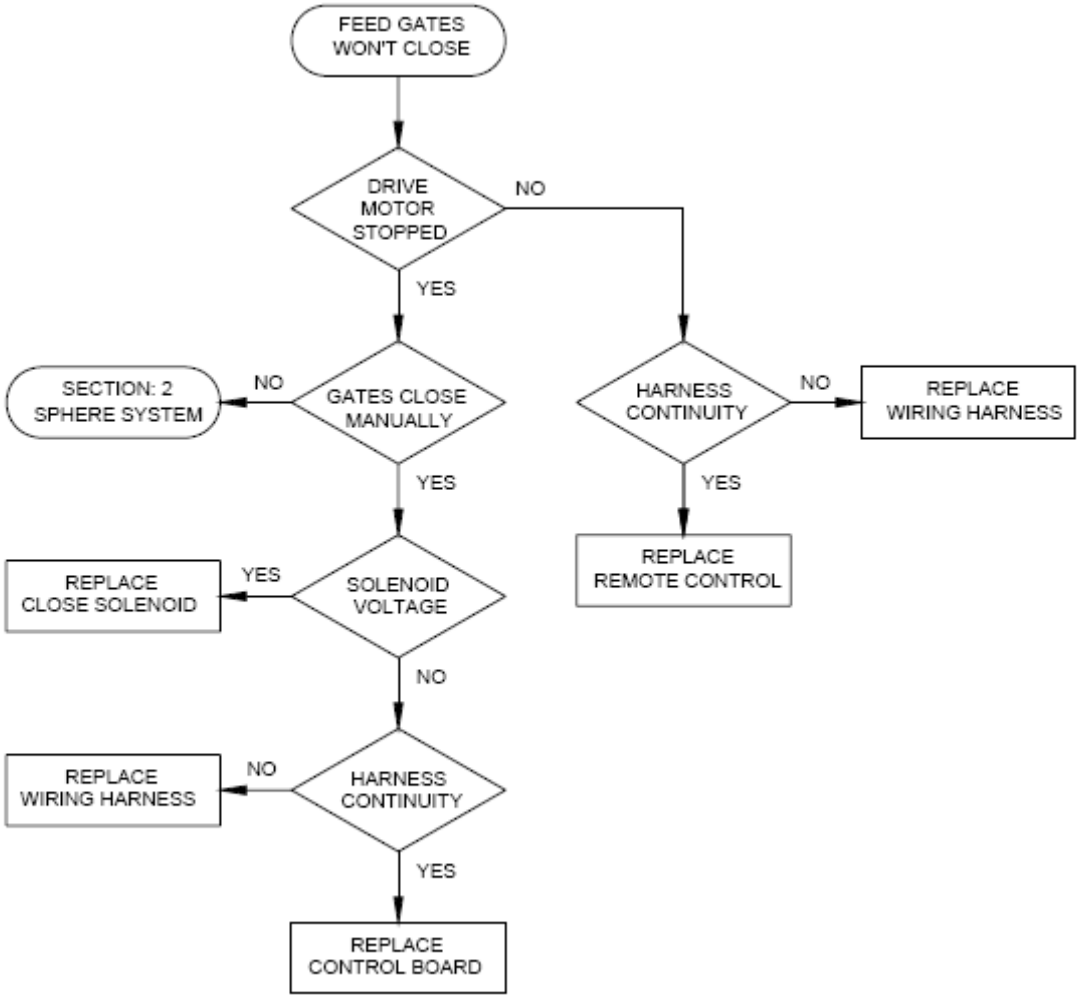
- Measure the continuity between the black motor lead and socket # 2 on the harness plug.
- If there is no continuity, replace the wiring harness.



Control Board Damaged

- Replace the main control board.

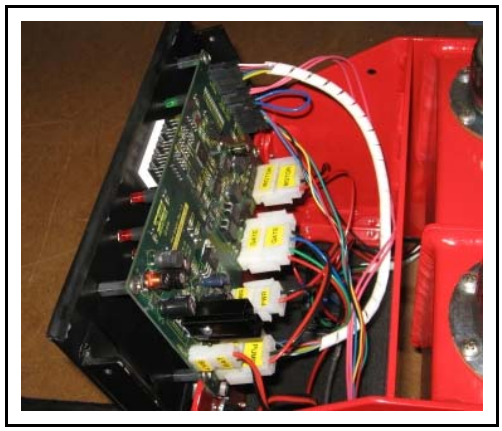
Feed Gates Won't Close



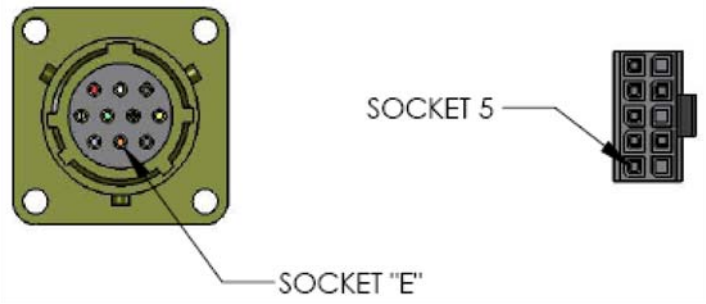
- Activate the close switch on the remote control.
- If the drive motor stops, go to subsection *Gates Close Manually.*

Remote Wiring Harness Damaged

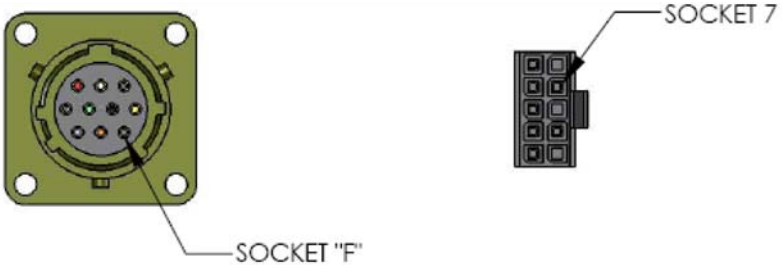
- Disconnect the external power supply to the dispenser.
- Disconnect the remote control plug from the receptacle on the front of the dispenser
- Remove the four #10-24 x 3/8 button head capscrews which secure the control panel to the tank assembly.
- Tilt the control panel forwards to access the main control board.



- Disconnect the remote wiring harness plug from the main control board.
- Check the continuity between socket “E” on the panel receptacle and socket “5” on the wiring harness plug.
- If there is no continuity, replace the remote wiring harness.



- Check the continuity between socket “F” on the panel receptacle and socket “7” on the wiring harness plug.
- If there is no continuity, replace the remote wiring harness.

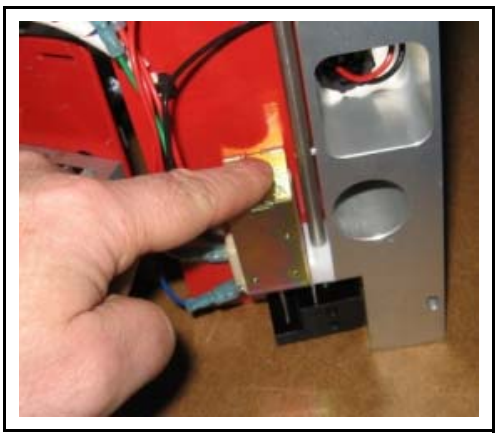


Remote Control Damaged

- Replace the remote control.

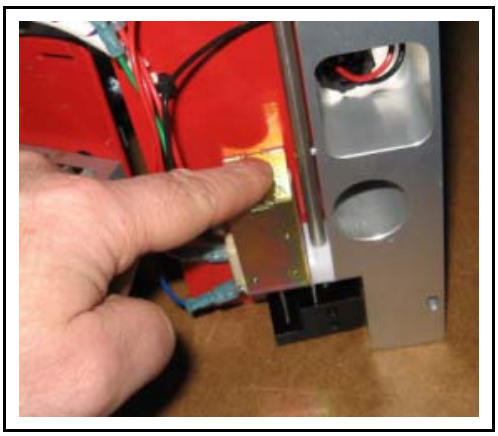
Gates Close Manually

- Remove the gate assembly.
- Press on the close solenoid core to try to close the gate.
- If the gates do not close and lock, go to *Section 2: Sphere Handling System*

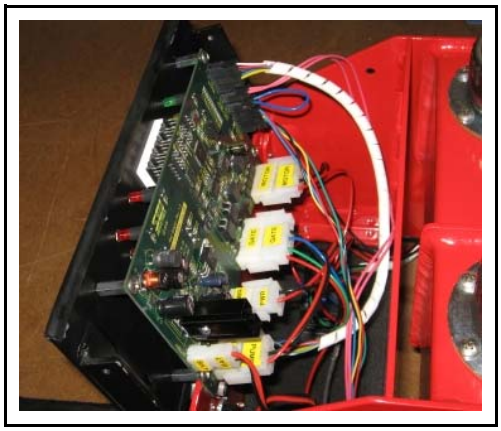


Close Solenoid Damaged

- Activate the open switch on the remote control.
- Measure the voltage across the close solenoid terminals while activating the close switch on the remote control.
- If there is a transient voltage increase, replace the close solenoid.

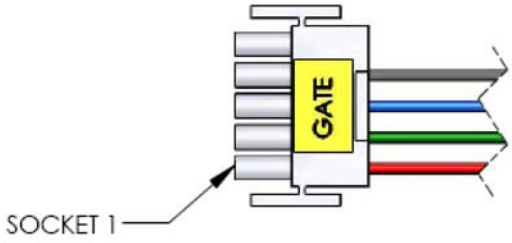


Gate Wiring Harness Damaged

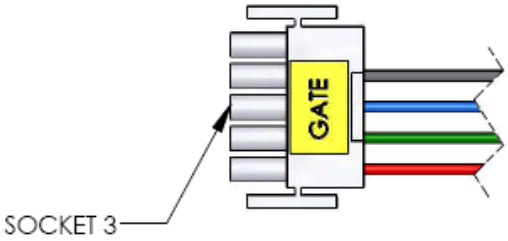


- Disconnect the external power supply to the dispenser.
- Remove the four #10-24 x 3/8 button head capscrews which secure the control panel to the tank assembly.
- Tilt the control panel forwards to access the main control board.
- Disconnect the gate wiring harness plug from the main control board.

- Check the continuity between socket “1” on the harness plug and the red wire on the close solenoid.
- If there is no continuity, replace the gate wiring harness.



- Check the continuity between socket “3” on the harness plug and the blue wire on the close solenoid.
- If there is no continuity, replace the gate wiring harness.



Control Board Damaged

- Replace the main control board.

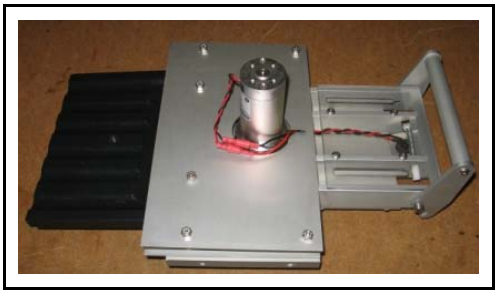
Section 6: Repairs for All Systems

Repair Guide

Hopper Motor Replacement

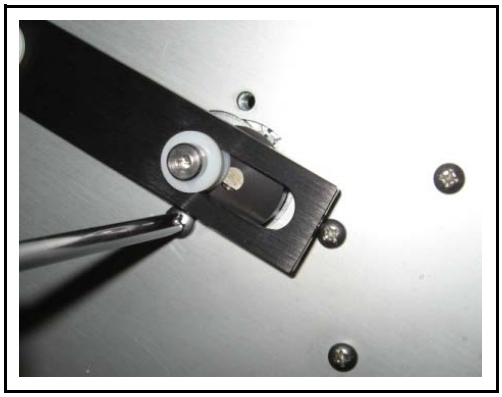
- Remove the four # 10-24 x 3/8 button head capscrews which secure the agitator mechanism to the hopper body.

- Remove the agitator mechanism from the hopper body



- Loosen the # 8-32 setscrew which secures the agitator cam to the hopper motor shaft.

- Remove the two # 10-32 x 3/8 screws which secure the hopper motor to the hopper base.



- Disconnect the hopper wiring harness from the hopper motor terminals.
- Remove the hopper motor from the agitator assembly.
- Install the new hopper motor into the agitator assembly and secure to the hopper base using two #10-32 x 3/8 screws.
- Attach the hopper wiring harness to the hopper motor.

- Align the motor shaft flat with the setscrew in the agitator cam and tighten the setscrew.

- Replace the agitator mechanism into the hopper body and secure using four # 10-24 x 3/8 button head capscrews.

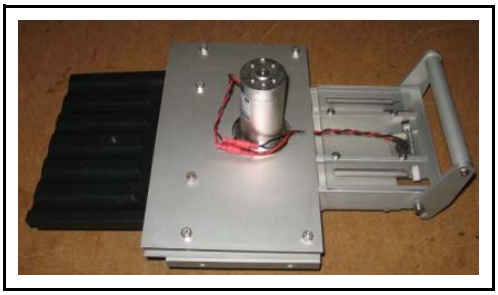
- Adjust the agitator adjuster mechanism as required.

- Install the hopper onto the gate assembly.
- Connect the dispenser to an external power supply.
- Check that the “POWER” indicator illuminates.
- Switch the “RUN/STOP” switch to the “RUN” position.
- Check that the hopper agitator operates.

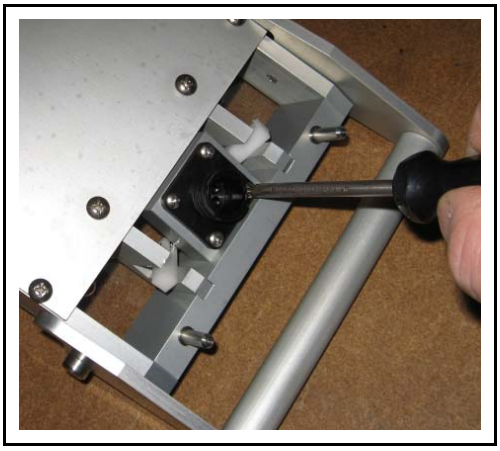
Hopper Motor Wiring Harness Replacement

- Remove the four # 10-24 x 3/8 button head capscrews which secure the agitator mechanism to the hopper body.

- Remove the agitator mechanism from the hopper body.



- Remove the four # 4-40 x 3/8 screws which secure the wiring harness receptacle to the agitator assembly.



- Disconnect the hopper wiring harness from the hopper motor terminals.
- Remove the hopper wiring harness.
- Install the new hopper wiring harness into the agitator assembly.
- Secure the wiring harness receptacle to the agitator assembly using four # 4-40 x 3/8 screws.
- Connect the hopper wiring harness to the hopper motor.

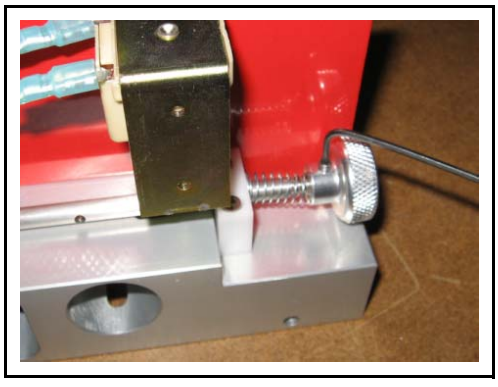
- Replace the agitator assembly into the hopper body and secure using four # 10-24 x 3/8 button head capscrews.

- Adjust the agitator adjuster mechanism as required

- Install the hopper onto the gate assembly.
- Connect the dispenser to an external power supply.
- Check that the “POWER” indicator illuminates.
- Switch the “RUN/STOP” switch to the “RUN” position.
- Check that the hopper agitator operates.

Feed Control Spring Replacement

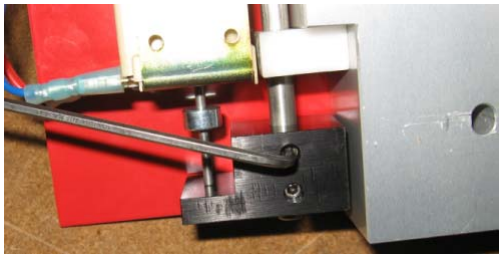
- Loosen screw which secures the manual feed gate knob to the feed control rod.
- Un-thread the knob from the feed control rod.
- Remove the feed control spring



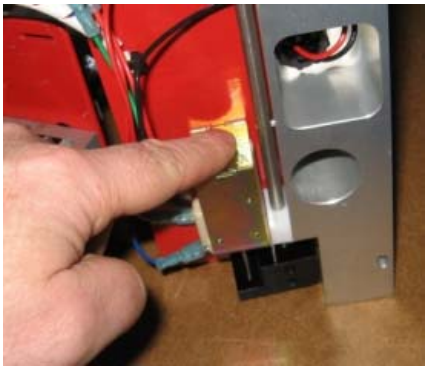
- Install the new spring onto the feed control rod.
- Thread the knob onto the rod until the face of the knob is 3/4” from the face of the pillow block which supports the feed control rod.
- Secure the knob in place using the setscrew.
- Install the gate assembly onto the injection head.
- Connect the dispenser to an external power supply.
- Check that the “POWER” indicator illuminates.
- Switch the “RUN/STOP” switch to the “RUN” position.
- Press the feed gate switch to the “OPEN” position.
- Check that the feed gates open.

Solenoid Activator Adjustment

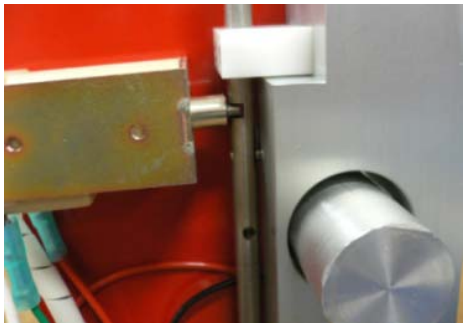
- Loosen the setscrews which secure the solenoid activator to the control rod.



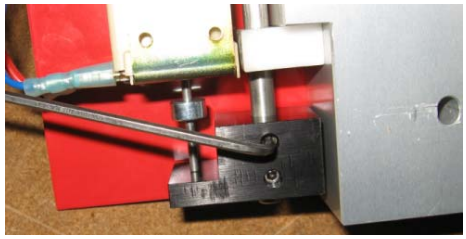
- Press on the close solenoid core to try to fully extend the pin on the close solenoid.



- Adjust the position of the control rod so that the locking pin on the open solenoid aligns with the groove in the feed control rod.



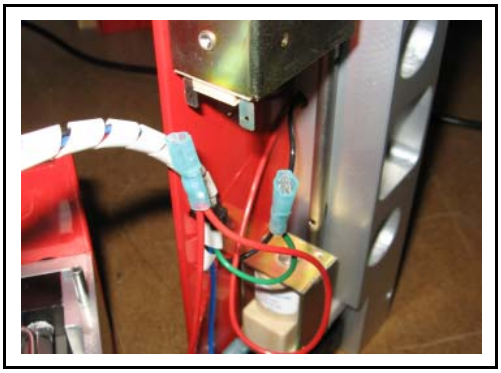
- Adjust the solenoid activator to touch the pin of the close solenoid.
- Secure the activator in place with its setscrews.



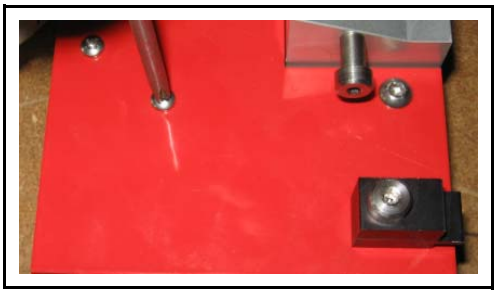
- Install the gate assembly onto the injection head.
- Connect the dispenser to an external power supply.
- Check that the “POWER” indicator illuminates.
- Switch the “RUN/STOP” switch to the “RUN” position.
- Press the feed gate switch to the “OPEN” position.
- Wait ten seconds and press the switch to the “CLOSE” position.
- Check that the feed gates close and lock.

Open Solenoid Replacement

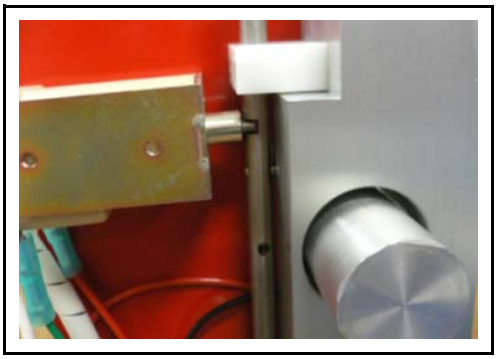
- Remove the gate assembly from the injection head
- Disconnect the gate wiring harness wires from the open solenoid terminals.



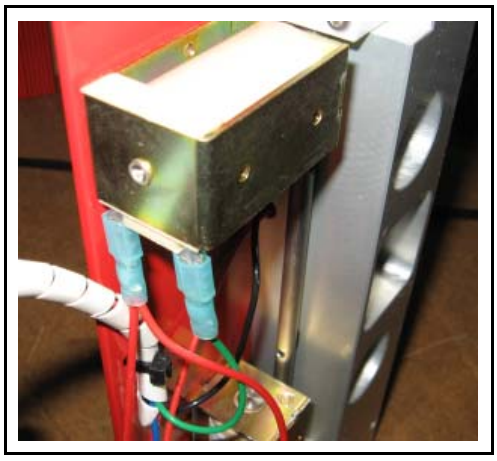
- Remove the two # 6-32 x 3/16 screws which secure the solenoid to the solenoid cover.
- Remove the solenoid.



- Install the new solenoid onto the solenoid cover and secure using two #6-32 x 3/16 screws, but do not tighten.
- Press on the close solenoid core and adjust the open solenoid position so that the locking pin aligns with groove in the feed control rod.
- Tighten the screws to secure the solenoid in place.



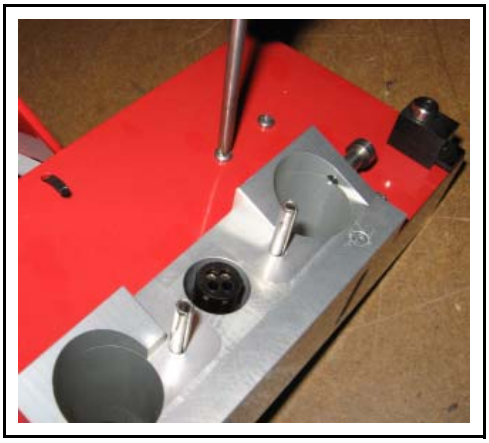
- Replace the gate wiring harness wires onto the open solenoid terminals.



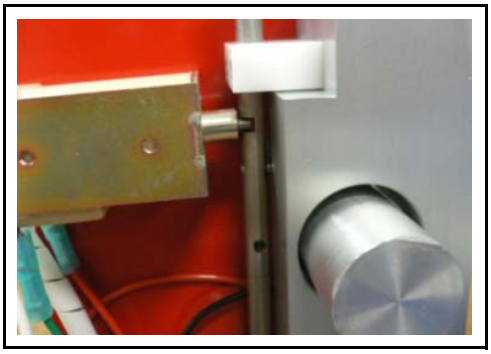
- Install the gate assembly onto the injection head.
- Connect the dispenser to an external power supply.
- Check that the “POWER” indicator illuminates.
- Switch the “RUN/STOP” switch to the “RUN” position.
- Press the feed gate switch to the “OPEN” position.
- Check that the feed gates open.

Close Solenoid Replacement

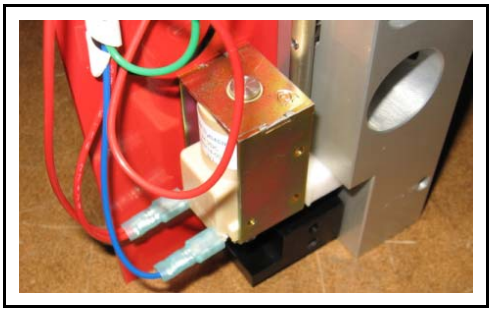
- Remove the gate assembly from the injection head
- Disconnect the gate wiring harness wires from the close solenoid terminals.



- Remove the four # 6-32 x 3/16 screws which secure the solenoid to the solenoid cover.
- Remove the solenoid.



- Install the new solenoid onto the solenoid cover and secure using two #6-32 x 3/16 screws, but do not tighten.
- Press on the close solenoid core and adjust the close solenoid position so that the locking pin on the open solenoid aligns with groove in the feed control rod.
- Tighten the screws to secure the solenoid in place.



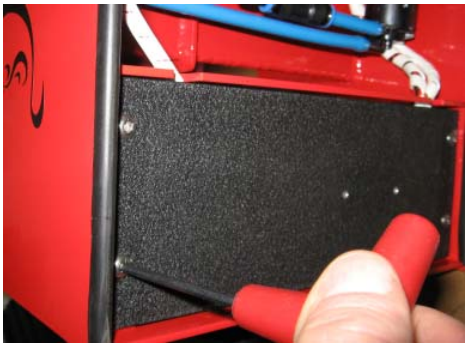
- Replace the gate wiring harness wires onto the close solenoid terminals.

- Install the gate assembly onto the injection head.
- Connect the dispenser to an external power supply.
- Check that the “POWER” indicator illuminates.
- Switch the “RUN/STOP” switch to the “RUN” position.
- Press the feed gate switch to the “OPEN” position.
- Wait ten seconds and press the switch to the “CLOSE” position.
- Check that the feed gates close.

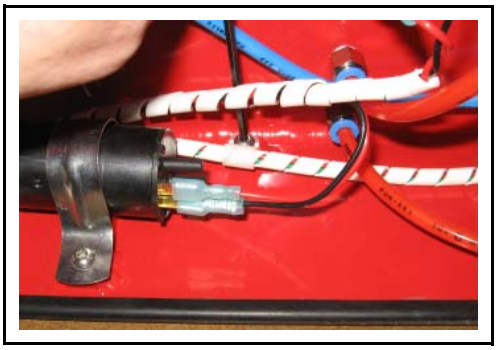
Gate Wiring Harness Replacement

- Disconnect the dispenser from the external power supply.
- Remove the four # 10-24 x 3/8 button head capscrews which secure the control panel to the tank assembly.
- Tilt the control panel forwards to access the main control board.
- Unplug the gate wiring harness from the main control board

- Remove the four #10-24 x 3/8 button head capscrews which secure the lower control cover to the tank assembly.
- Remove the control cover.

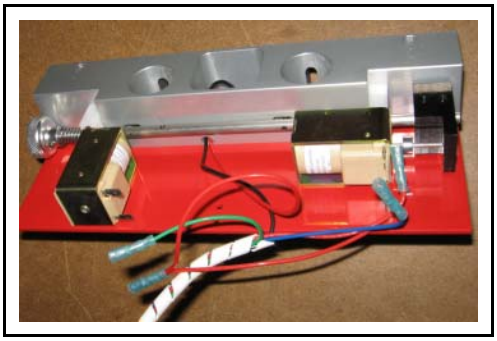


- Remove the tie wrap which secures the motor and pump wiring harnesses to the gate wiring harness.
- Remove the # 10-32 x 3/8 button head capscrew and P-clip which secures the wiring harness in place.

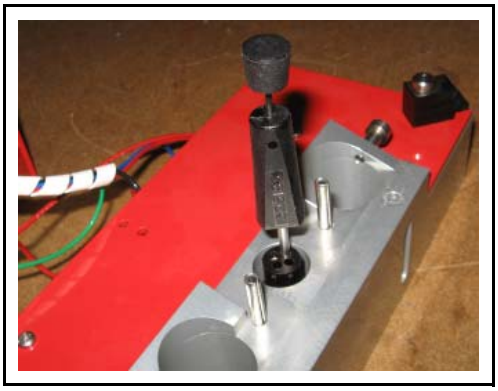


- Remove the gate assembly from the injection head.
- Cut and remove the tie wrap which secures the gate wiring harness to the solenoid cover.

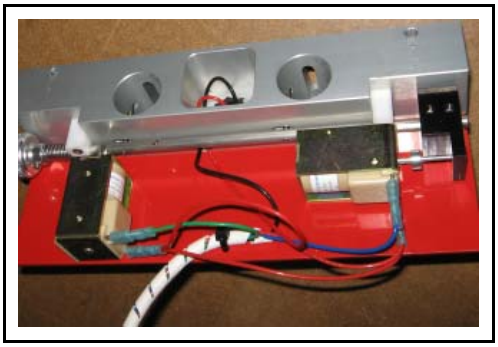
- Disconnect the wiring harness connectors from the open solenoid.
- Disconnect the wiring harness connectors from the close solenoid.



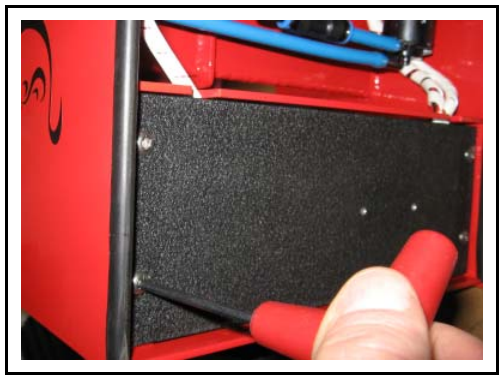
- Disconnect the two wires from the gate receptacle using special extraction tool AMP # 305183.
- Remove the wiring harness from the gate assembly.



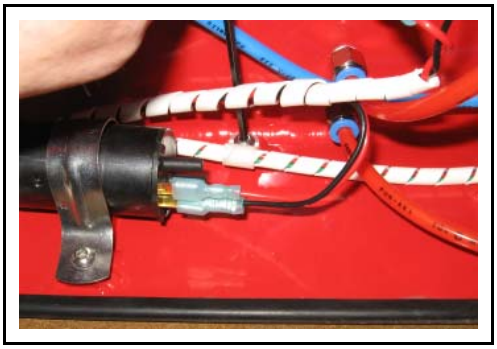
- Install the new wiring harness onto the gate assembly.
- Install the red lead into receptacle socket # 1.
- Install the black lead into receptacle socket # 2.
- Attach the red and green leads to the open solenoid.
- Attach the red and blue leads to the close solenoid.
- Secure the wire harness to the gate assembly using a tie wrap.



- Route the wiring harness and plug into the main control board.
- Replace the lower control cover and secure in place using four # 10-24 x 3/8 button head capscrews.



- Secure the gate wiring harness to the tank assembly using the P-clip.
- Replace the tie wrap which secures the pump and motor wiring harnesses to the gate wiring harness.

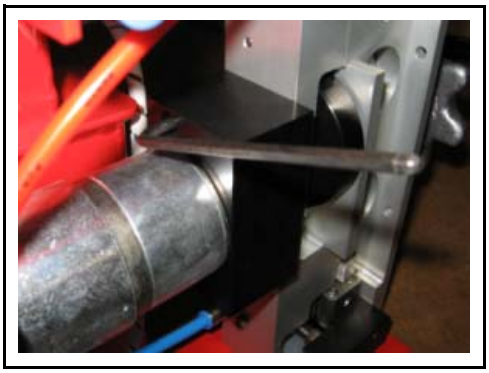


- Install the gate assembly onto the injection head.
- Install the hopper onto the gate assembly.
- Connect the dispenser to an external power supply.
- Check that the “POWER” indicator illuminates.
- Switch the “RUN/STOP” switch to the “RUN” position.

- Check that the hopper agitator operates
- Press the feed gate switch to the “OPEN” position.
- Check that the feed gates open.
- Wait ten seconds and press the switch to the “CLOSE” position.
- Check that the feed gates close.

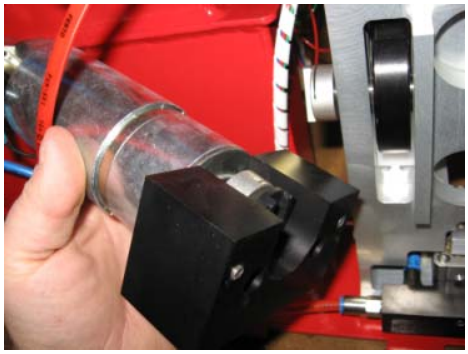
Drive Coupling Replacement

- Remove the gate assembly.
- Loosen the setscrew on the motor shaft coupling hub.
- Loosen the setscrew on the drive shaft coupling hub.



- Remove the two #10-32 x 1-1/4 socket head capscrews which secure the motor mount to the injection head.

- Remove the motor and motor mount being careful to support the motor so that the wires are not strained.
- Remove both of the coupling hubs and the connector disk.

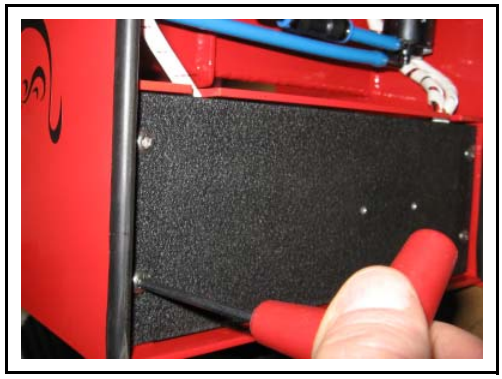


- Install the new coupling hubs and the connector disk onto the motor shaft and drive shaft.
- Attach the motor mount to the injection head and secure using four #10-32 x 1-1/4 socket head capscrews.
- Adjust the coupling hubs to that they are tight against the connector disk and the coupling assembly is centred between the motor shaft and drive shaft.
- Secure in place using hub setscrews.

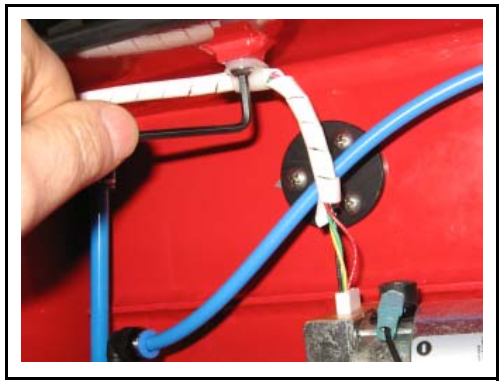
Drive Motor Replacement

- Disconnect the dispenser from external power supply.
- Remove the four # 10-24 x 3/8 button head capscrews which secure the control panel to the tank assembly.
- Tilt the control panel forwards to access the main control board.
- Unplug the motor encoder from the main control board.

- Remove the four #10-24 x 3/8 button head capscrews which secure the lower control cover to the tank assembly.
- Remove the control cover.



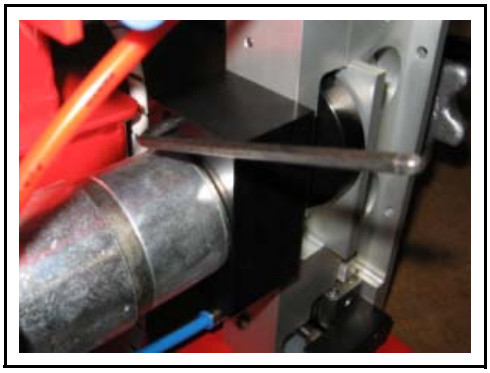
- Remove the P-clip which secures the encoder and level switch wires to the tank assembly.
- Remove the spiral wrap from the encoder and level switch wires.



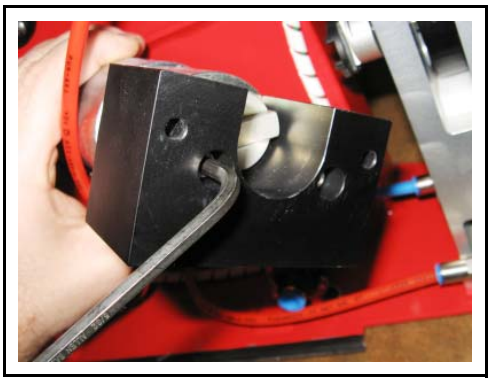
- Disconnect the motor wiring harness from the motor terminals.

- Remove the gate assembly.
- Loosen the setscrew on the motor shaft coupling hub.

- Remove the two #10-32 x 1-1/4 socket head capscrews which secure the motor mount to the injection head.

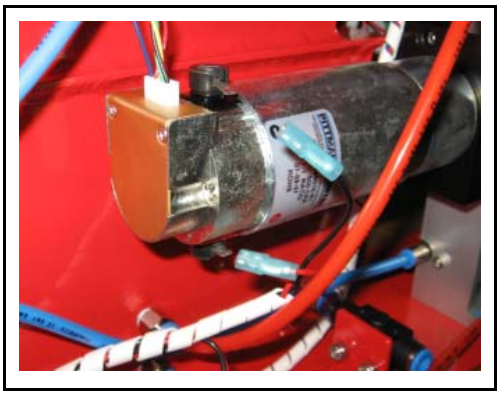


- Remove the motor and motor mount.
- Remove the two #10-32 x 1-1/4 socket head capscrews which secure the motor to the motor mount.
- Remove the coupling hub from the motor.
- Install the motor mount onto the new motor and secure in place using two #10-32 x 1-1/4 socket head capscrews.
- Install the coupling hub onto the motor shaft but do not tighten the setscrew.

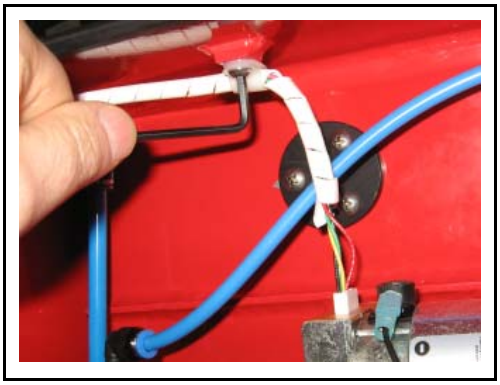


- Attach the motor mount to the injection head and secure using two #10-32 x 1-1/4 socket head capscrews.
- Adjust the coupling hubs to that they are tight against the connector disk and the coupling assembly is centred between the motor shaft and drive shaft.
- Secure in place using hub setscrews.

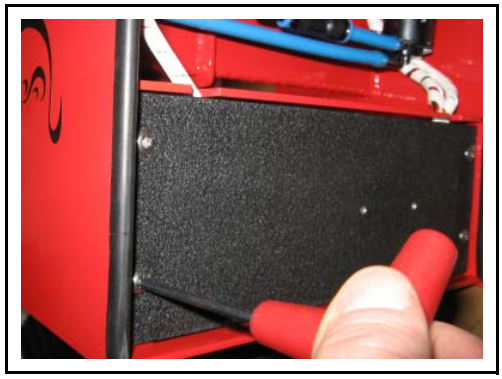
- Re-attach the motor wiring harness to the new motor ensuring that the red lead is attached to the positive terminal.



- Replace the spiral wrap on the encoder and level switch wires.
- Replace the P-clip which secures the encoder and level switch wires to the tank assembly.



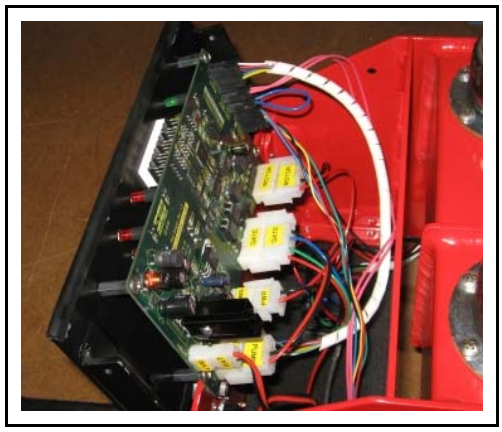
- Replace the lower control cover and secure in place using four # 10-24 x 3/8 button head capscrews.



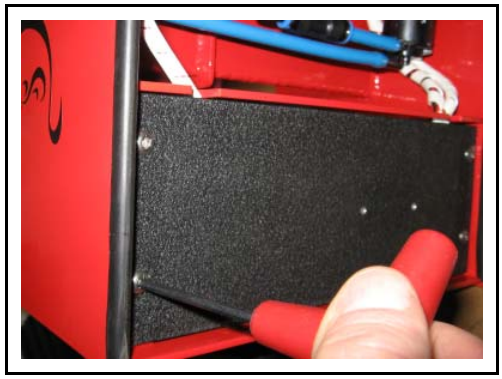
- Plug the motor encoder into the main switch board.
- Replace the control panel and secure using four # 10-24 x 3/8 button head capscrews.

- Connect the dispenser to an external power supply.
- Check that the “POWER” indicator illuminates.
- Switch the “RUN/STOP” switch to the “RUN” position.
- Press the feed gate switch to the “OPEN” position.
- Check that the drive motor operates.

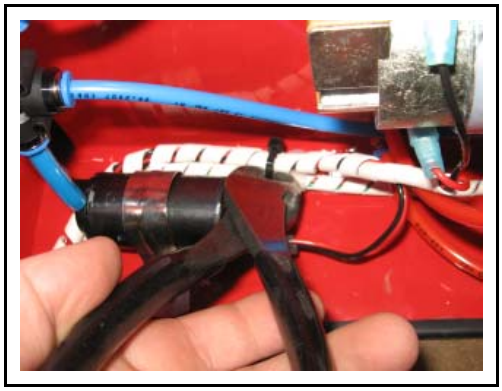
Drive Motor Wiring Harness Replacement



- Disconnect the dispenser from external power supply.
- Remove the four # 10-24 x 3/8 button head capscrews which secure the control panel to the tank assembly.
- Tilt the control panel forwards to access the main control board.
- Unplug the motor wiring harness from the main control board.



- Remove the four #10-24 x 3/8 button head capscrews which secure the lower control cover to the tank assembly.
- Remove the control cover.

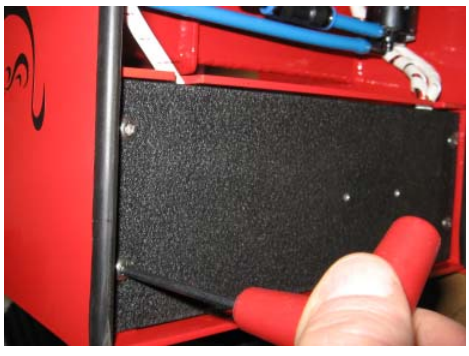


- Remove the tie wrap which secures the pump and motor wiring harnesses to the gate wiring harness.
- Remove the spiral wrap from the pump and motor wiring harnesses.

- Disconnect the motor wiring harness from the drive motor.
- Remove the motor wiring harness.
- Attach the new motor wiring harness to the motor ensuring that the red lead is attached to the positive terminal.

- Replace the spiral wrap onto the pump and motor wiring harnesses.
- Secure the pump and motor wiring harnesses to the gate wiring harness using a tie wrap.
- Install the wiring in the cutout above the lower control cover.

- Replace the lower control cover and secure in place using four # 10-24 x 3/8 button head capscrews.

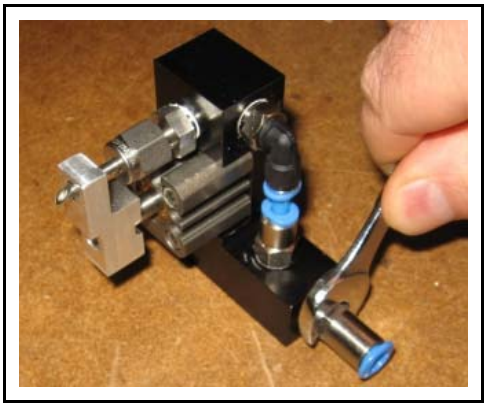


- Plug the motor wiring harness into the main control board.
- Replace the control panel and secure using four # 10-24 x 3/8 button head capscrews.

- Connect the dispenser to an external power supply.
- Check that the “POWER” indicator illuminates.
- Switch the “RUN/STOP” switch to the “RUN” position.
- Press the feed gate switch to the “OPEN” position.
- Check that the drive motor operates.

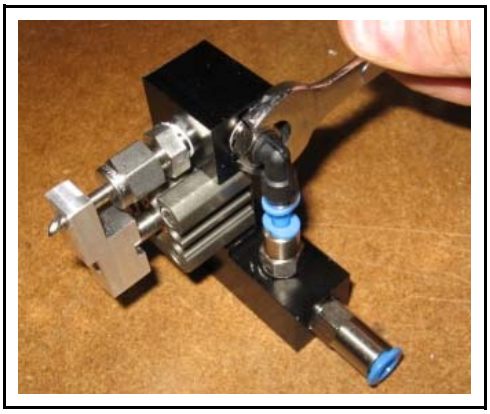
Inlet Check Valve Replacement

- Unscrew the inlet check valve from the manifold block.
- Install new inlet check valve in manifold block.

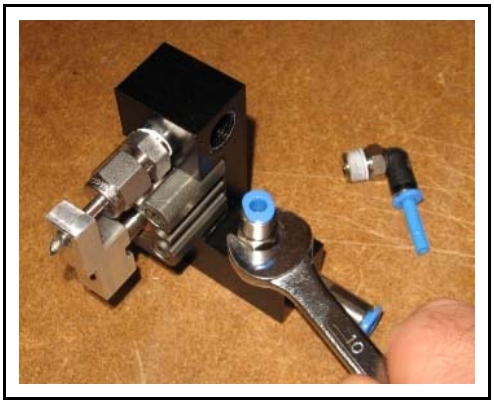


- Press and hold the pump arm.
- Hold the glycol supply line over the inlet check valve so that the valve fills with glycol.
- Reconnect the supply line into the check valve.
- Release the pump arm.
- Press and release the pump arm repeatedly until the pump primes.

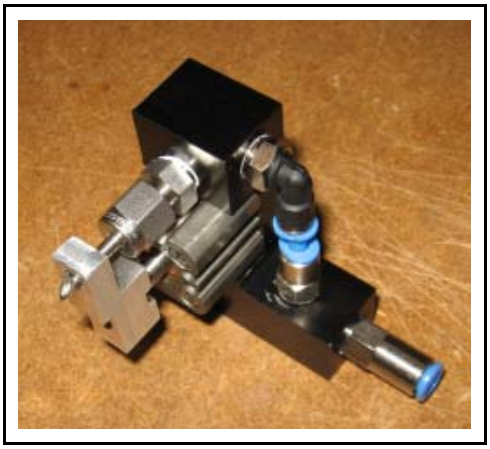
Outlet Check Valve Replacement



- Un-thread the elbow from the manifold block.



- Remove elbow and tube from outlet check valve.
- Un-thread the outlet check valve from the manifold block.

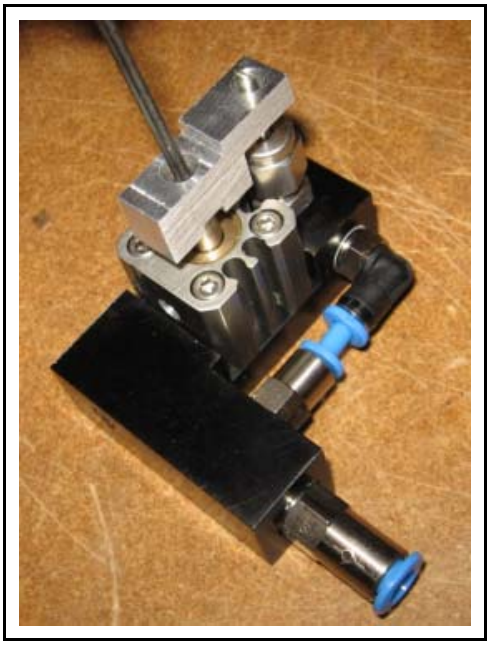


- Install new outlet check valve in manifold block.
- Replace elbow and tube into check valve.
- Install elbow into manifold block.

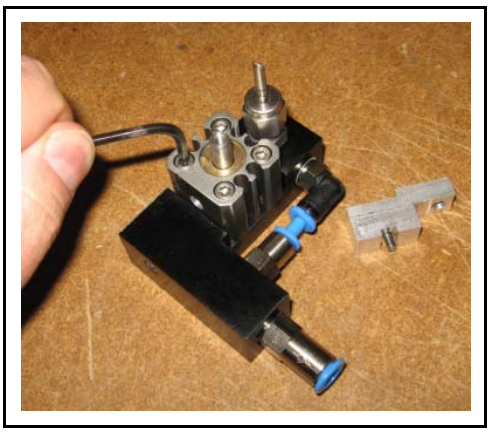
- Press and hold the pump arm.
- Hold the glycol supply line over the inlet check valve so that the valve fills with glycol.
- Reconnect the supply line into the check valve.
- Release the pump arm.
- Press and release the pump arm repeatedly until the pump primes.

Glycol Pump Replacement

- Remove the 3mm x 1.5 socket head capscrew that secures the pump arm to the pump piston.
- Remove the pump arm.

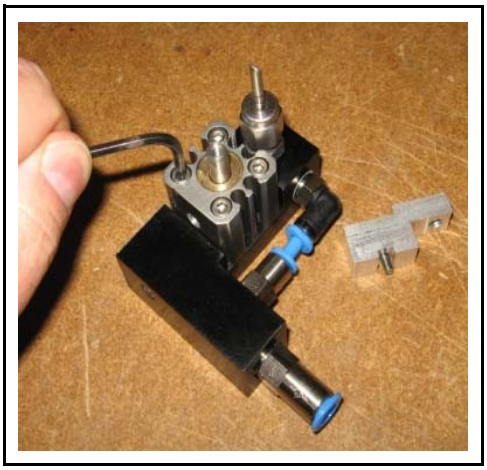


- Remove four # 6-32 x 7/8 socket head capscrews that secure the pump to the manifold block.
- Remove the pump.

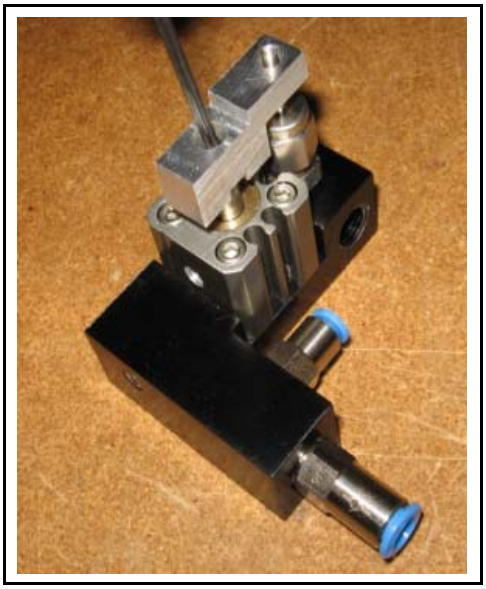


- Remove the O-ring from the pump.
- Install the O-ring onto the new pump.

- Replace the pump onto the manifold block.
- Hold pressure on the O-ring and secure the pump cylinder to the manifold block using four #6-32 x 7/8 socket head cap-screws.



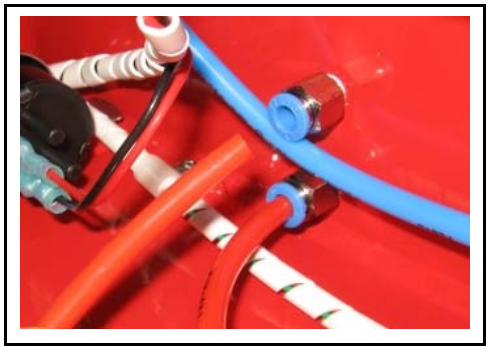
- Replace the pump arm and secure to the pump piston using the 3mm x 1.5 socket head capscrews.



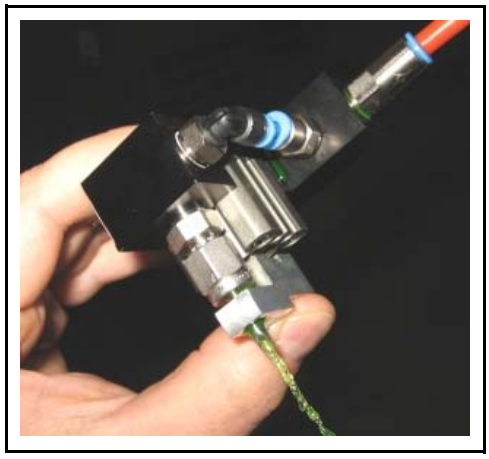
- Press and hold the pump arm.
- Hold the glycol supply line over the inlet check valve so that the valve fills with glycol.
- Reconnect the supply line into the check valve.
- Release the pump arm.
- Press and release the pump arm repeatedly until the pump primes.

Suction Line Replacement

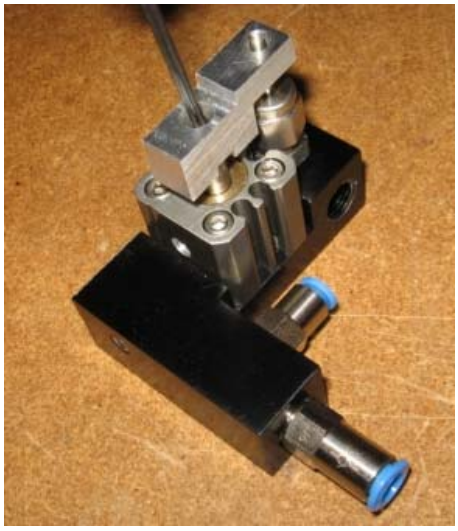
- Drain the glycol tank.
- Remove the suction line from the tank adapter fitting.
- Check that the tank adapter fitting is not plugged.
- Install new suction line into the tank adapter fitting.



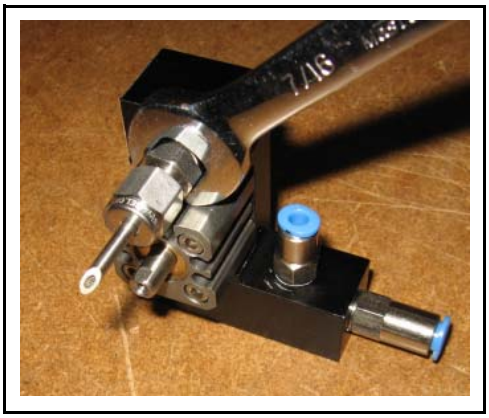
- Press and hold the pump arm.
- Hold the glycol supply line over the inlet check valve so that the valve fills with glycol.
- Reconnect the supply line into the check valve.
- Release the pump arm.
- Press and release the pump arm repeatedly until the pump primes.



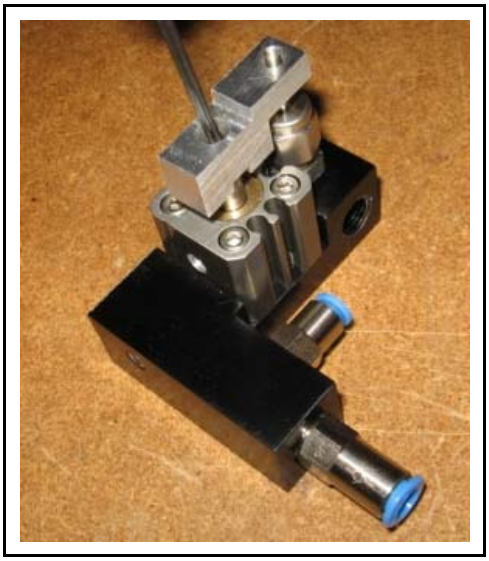
Injection Needle Replacement



- Remove the 3mm x 1.5 socket head capscrew that secures the pump arm to the pump piston.
- Remove the pump arm.

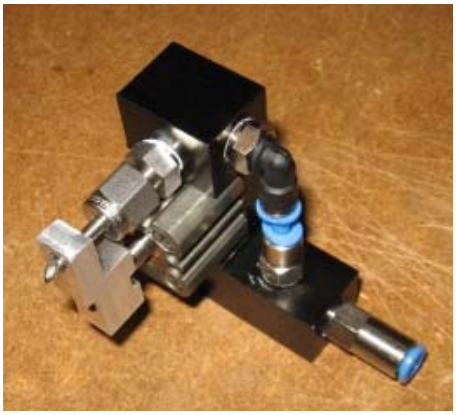


- Remove the injection needle from the manifold block.
- Repair or replace the needle in the manifold block.



- Replace the pump arm and secure to the pump piston using the 3mm x 1.5 socket head capscrews.

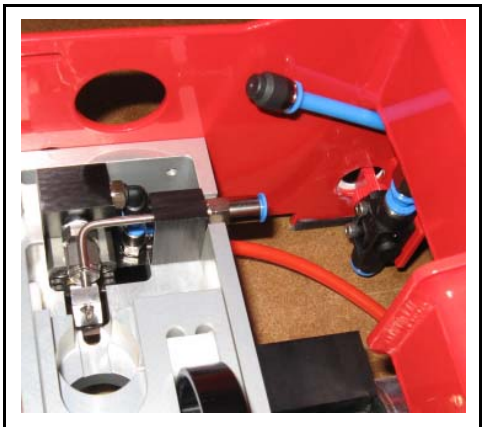
- Replace the elbow and tubing into the outlet check valve.
- Replace the elbow into the manifold block.



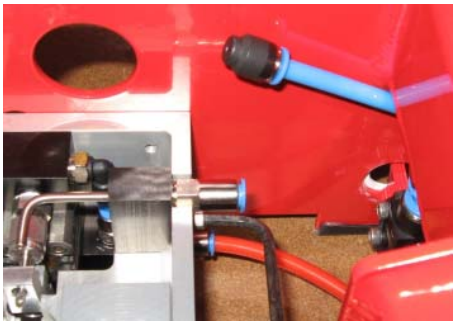
- Press and hold the pump arm.
- Hold the glycol supply line over the inlet check valve so that the valve fills with glycol.
- Reconnect the supply line into the check valve.
- Release the pump arm.
- Press and release the pump arm repeatedly until the pump primes.

Check Valve Replacement

- Disconnect the water line from the check valve and cap the water line.



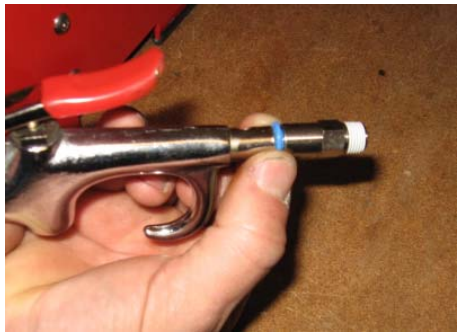
- Remove the # 8-32 x 1/2 socket head capscrew that secures the water nozzle assembly to the injection head.



- Remove the water nozzle assembly from the injection head.

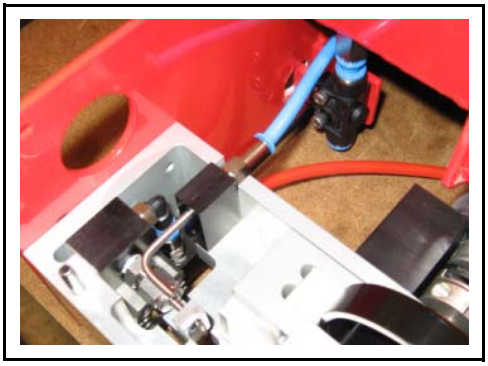
- Remove check valve from nozzle assembly

- Blow out check valve with compressed air in the normal flow direction to clean the valve.

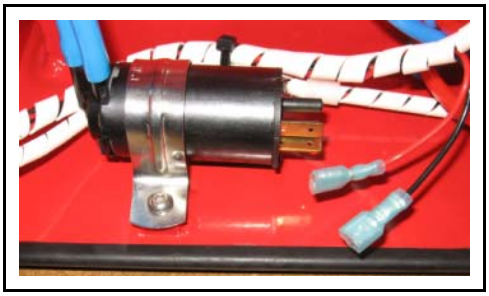


- Blow air in the reverse direction.
- If air does not flow, reinstall into the nozzle assembly.
- If air does flow, install a new check valve into the nozzle assembly.

- Replace nozzle assembly into injection head and secure with # 8-32 x 1/2 socket head capscrew.
- Reconnect the water discharge line to the check valve.



Water Pump Replacement

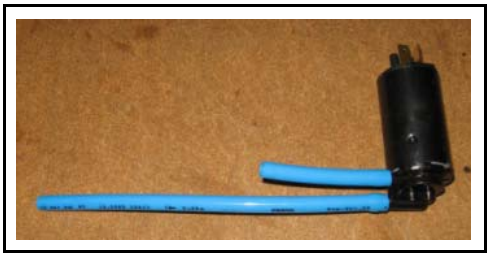


- Drain the water tank using the tank drain valve.
- Disconnect the pump wiring harness from the pump motor.

- Disconnect the pump suction line from the elbow in the bottom of the water tank.
- Disconnect the pump discharge line from the T-fitting.

- Remove the lower # 10-24 x 3/8 button head capscrew that secures the pump bracket.
- Pivot the bracket around the remaining capscrew and remove the water pump complete with the suction and discharge tubing.

- Cut a piece of 8mm x 7-3/4” blue tubing and install on the new pump suction port.
- Cut a piece of 8mm x 2-1/2” blue tubing and install on the new pump discharge port.

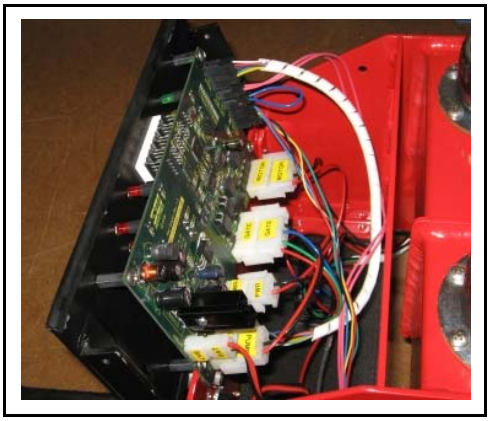


- Install the pump and bracket, and secure with the # 10-24 x 3/8 button head capscrew.

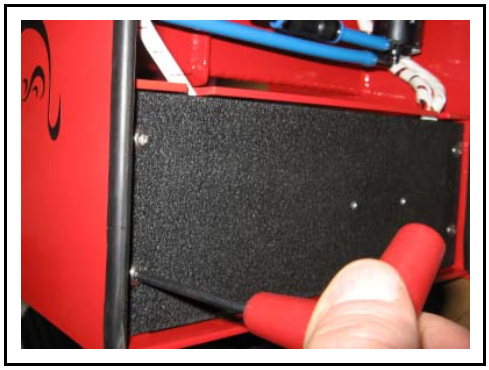
- Connect the pump suction tube to the elbow in the bottom of the water tank.
- Connect the pump discharge tube to the T fitting.

- Connect the black pump lead of the wiring harness to the negative terminal of the pump.
- Connect the red pump lead of the wiring harness to the positive terminal of the pump.

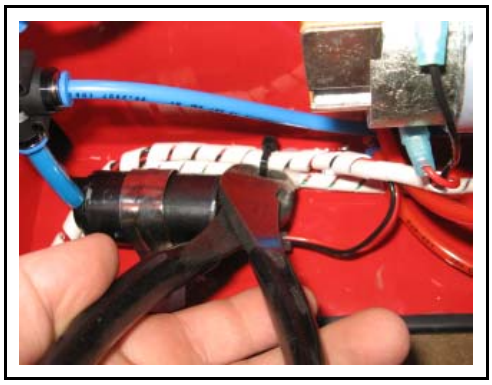
Water Pump Wiring Harness Replacement



- Disconnect the dispenser from external power supply.
- Remove the four # 10-24 x 3/8 button head capscrews which secure the control panel to the tank assembly.
- Tilt the control panel forwards to access the main control board.
- Unplug the pump wiring harness from the main control board.

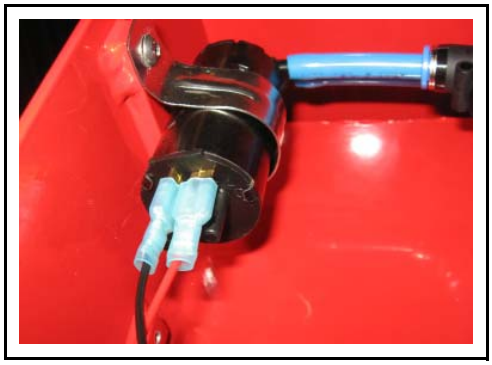


- Remove the four #10-24 x 3/8 button head capscrews which secure the lower control cover to the tank assembly.
- Remove the control cover.

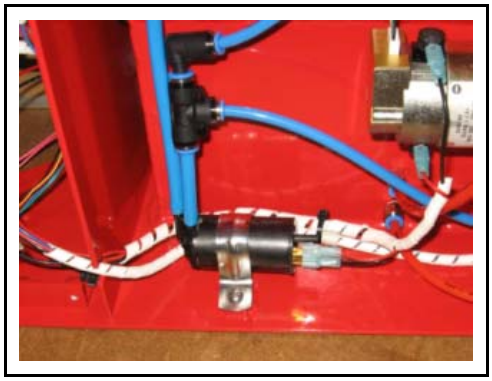


- Remove the tie wrap which secures the pump and motor wiring harnesses to the gate wiring harness.
- Remove the spiral wrap from the pump and motor wiring harnesses.
- Disconnect the pump wiring harness from the pump.
- Remove the pump wiring harness.

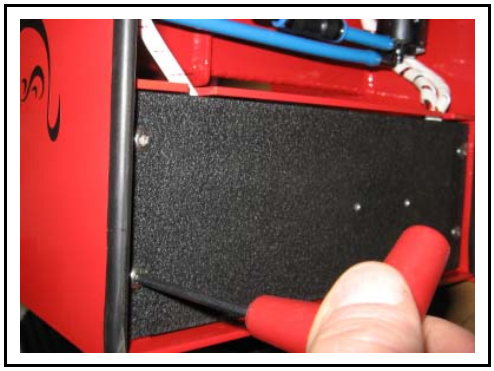
- Attach the new pump wiring harness to the pump ensuring that the red lead is attached to the positive terminal



- Replace the spiral wrap onto the pump and motor wiring harnesses.
- Secure the pump and motor wiring harnesses to the gate wiring harness using a tie wrap.
- Install the wiring in the cutout above the lower control cover.



- Replace the lower control cover and secure in place using four #10-24 x 3/8 button head capscrews.

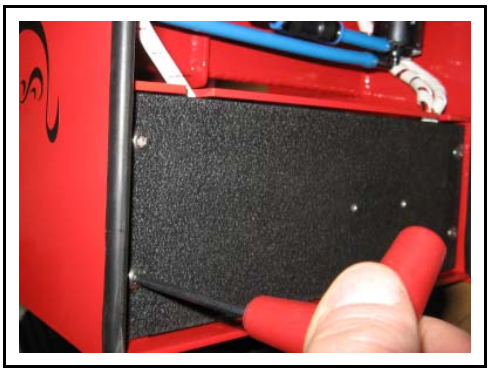


- Plug the pump wiring harness into the main control board.
- Replace the control panel and secure using four # 10-24 x 3/8 button head capscrews.

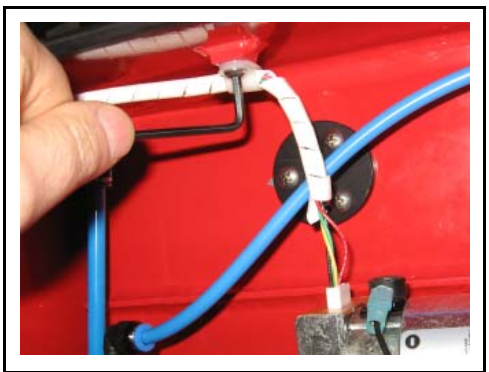
- Press the “WATER” switch to the “ON” position.
- Check that water pump operates.

Level Switch Replacement

- Disconnect the dispenser from external power supply.
- Remove the four # 10-24 x 3/8 button head capscrews which secure the control panel to the tank assembly.
- Tilt the control panel forwards to access the main control board.
- Unplug the level switch from the main control board.



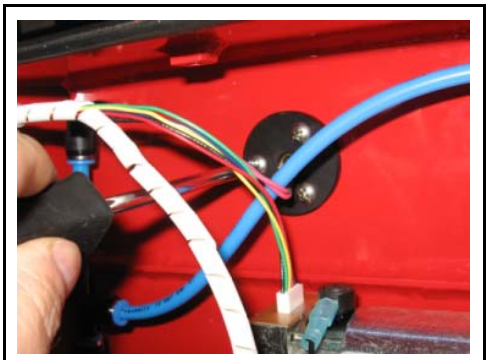
- Remove the four #10-24 x 3/8 button head capscrews which secure the lower control cover to the tank assembly.
- Remove the control cover.



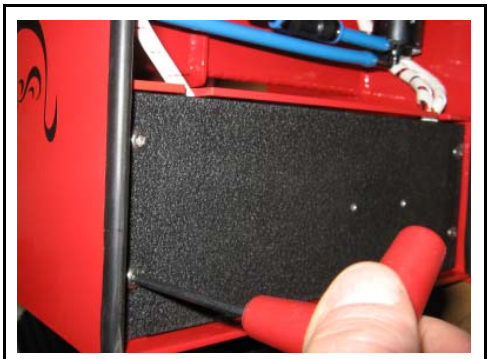
- Remove the P-clip which secures the encoder and level switch wires to the tank assembly.
- Remove the spiral wrap from the encoder and level switch wires.

- Remove the three # 10-32 x 3/8 seal screws which secure the level switch to the tank.
- Remove the old level switch assembly.

- Install the new level switch and O-ring into the tank and secure using three # 10-32 x 3/8 seal screws. Replace the spiral wrap onto the encoder and level switch wires.
- Secure the wires in place using a # 10-32 x 3/8 button head capscrew and a P-clip.



- Install the wiring in the cutout above the lower control cover.
- Replace the lower control cover and secure in place using four #10-24 x 3/8 button head capscrews.

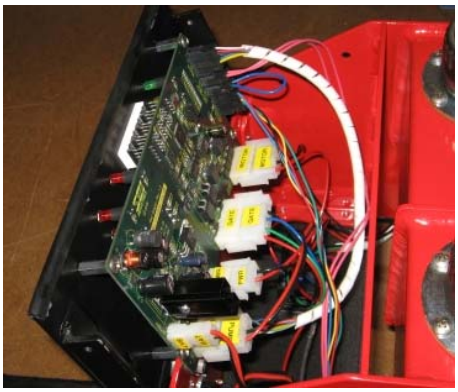


- Plug the level switch into the main control board.
- Replace the control panel and secure using four # 10-24 x 3/8 button head capscrews.

- Connect the dispenser to an external power supply.
- Check that the “POWER” indicator illuminates.
- Wait five seconds and check that the “LOW WATER” indicator illuminates.
- Fill the water tank.
- Check that the “LOW WATER” indicator extinguishes.

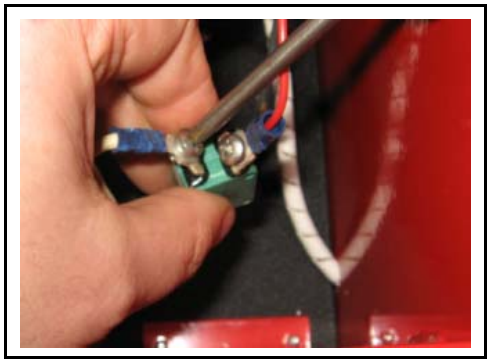
Main Circuit Breaker Replacement

- Disconnect the dispenser from external power supply.
- Remove the four # 10-24 x 3/8 button head capscrews which secure the control panel to the tank assembly.
- Tilt the control panel forwards to access the main circuit breaker.



- Remove the nut on the front of the panel which secures the circuit breaker.

- Disconnect the power wiring harness from the main circuit breaker.



- Check that the replacement circuit breaker is a 5A type MS3220 breaker.
- Cut away the locating tab on the new circuit breaker using side cutters.

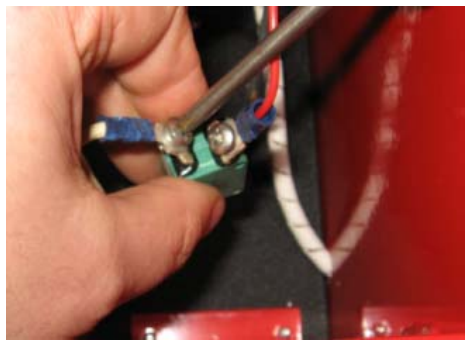
- Reconnect the red and white power harness wires to the new circuit breaker.
- Install the circuit breaker into the front panel and secure with the nut.
- Replace the control panel and secure with four # 10-24 x 3/8 button head screws.

- Pull out the circuit breaker to the tripped position.
- Connect the dispenser to an external power supply.
- Check that the “POWER” indicator on the main control panel is not illuminated.
- Push in the circuit breaker to reset
- Check that the “POWER” indicator on the main control panel illuminates.

Power Wiring Harness Replacement

- Disconnect the dispenser from external power supply.
- Remove the four # 10-24 x 3/8 button head capscrews which secure the control panel to the tank assembly.
- Tilt the control panel forwards to access the main control board.
- Unplug the power wiring harness from the main control board.

- Remove the nut on the front of the panel which secures the circuit breaker.

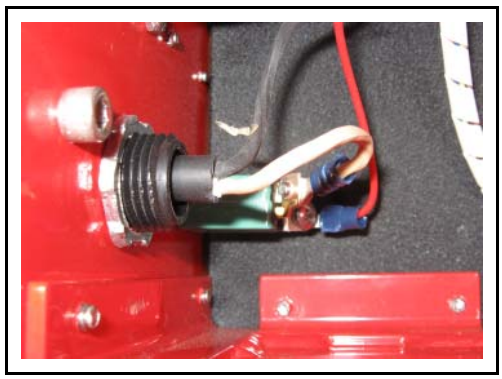


- Disconnect the power wiring harness from the main circuit breaker.

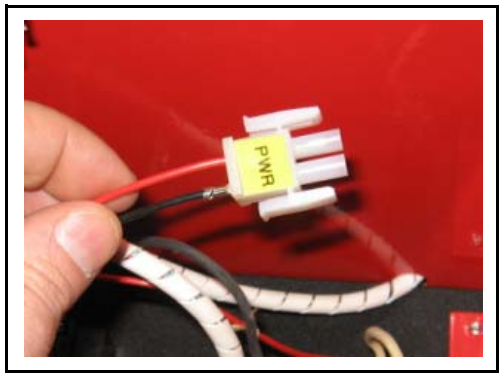
- Cutaway the plug on the old wiring harness.

- Loosen the nut on the strain relief.
- Remove the old wiring harness by pulling it through the strain relief.

- Install the new wiring harness into the front panel so that the insulation on the cable jacket protrudes approximately 1/4” past the strain relief.
- Tighten the strain relief.



- Install the plug onto the wiring harness with the red lead in socket # 1 and the black lead into socket # 2.
- Plug the wiring harness into the main control board.



- Connect the new power harness to the main circuit breaker.
- Replace the circuit breaker into the front panel.
- Replace the control panel and secure with four # 10-24 x 3/8 button head screws.

- Connect the dispenser to an external power supply.
- Push in the circuit breaker to reset.
- Check that the “POWER” indicator on the main control panel illuminates.

Battery Replacement

- Disconnect the dispenser from external power supply.
- Remove the four # 10-24 x 3/8 button head capscrews which secure the control panel to the tank assembly.
- Tilt the control panel forwards to access the main control board.

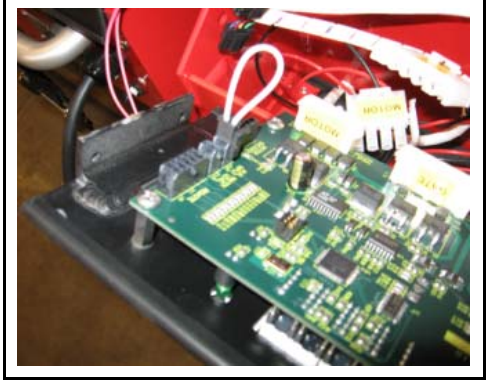
- Unplug the battery from the main control board.
- Remove the old battery.
- Install the new battery and connect to the main control board.

- Replace the control panel and secure in place using four #10-24 x 3/8 button head capscrews.

- Press the “WATER” switch to the “ON” position.
- Check that water flows from both water nozzles.

Main Control Board Replacement

- Disconnect the dispenser from external power supply.
- Remove the four # 10-24 x 3/8 button head capscrews which secure the control panel to the tank assembly.
- Tilt the control panel forwards to access the main control board.

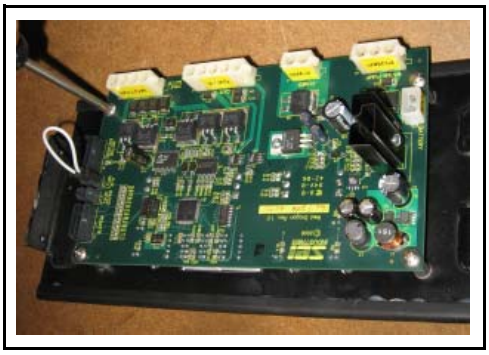


- Unplug the battery from the main control board.
- Unplug the pump wiring harness.
- Unplug the power wiring harness.
- Unplug the gate wiring harness.
- Unplug the motor wiring harness.

- Unplug the motor encoder.
- Unplug the level switch.
- Unplug the remote control wiring harness.

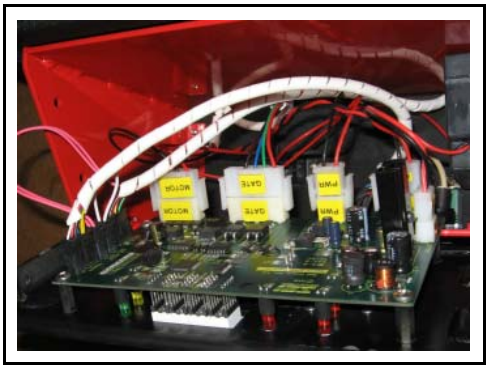
- Remove the control panel from the dispenser.
- Remove the switch boots from the three toggle switches.

- Remove the four # 8-32 x 1/4 screws which secure the main control board to the control panel.
- Remove the main control board.



- Install the new control board onto the control panel and secure using four # 8-32 x 1/4 screws.
- Replace the switch boots.

- Re-attach all of the electrical connections to the main control board.



- Replace the control panel and secure in place using four #10-24 x 3/8 button head capscrews.

Section 7: Supplier Cross Reference

Supplier Chart

The purpose of this section is to provide a cross reference to alternate parts suppliers for the non-proprietary components used in the dispenser. The item number in the table corresponds to the item number used in the expanded drawings in the previous sections of the manual.

Contact information for the various suppliers can be found at the end of this section.

Item	Description	SEI Part #	Alternate Supplier	Supplier Part #
100	O-RING, BUNA N, #007, 50A	005112	McMaster Carr	9452K15
101	ELBOW, STR90, 1/8MNPT x 4MM	003643	Festo	153334
102	TUBE, PUN, 4MM x 0.75MM, BLU	004216	Festo	178410
103	VALVE, NON-RETURN, 1/8MNPT > 4MM	004228	Festo	153446
104	VALVE, NON-RETURN, 6MM > 1/8MNPT	004230	Festo	153449
105	BUSHING, FL, BRZ, 3/8 x 1/2 x 5/16	005982	Symmco	SF-1216-5
107	BUSHING, FL, BRZ, 1/2 x 5/8 x 1/4	005109	Symmco	SF-1620-4
108	COUPLING, OLDHAM, CLAMP, 1/4 SHAFT	005137	Stock Drive Products	AFZ15-332508
109	SPRING, COMP , 0.375 x 0.025 x 1.50	005990	McMaster Carr	9657K33
110	FILLER NECK	005997	Shaw	910-2119-01
111	O-RING, BUNA N, #029, 50A	005993	McMaster Carr	9452K116
112	ELBOW, STR90, 1/8MNPT x 8MM	003649	Festo	153048
113	PUMP, 12VDC	006003	NAPA	BK 6651593
114	PUMP BRACKET	002982	McMaster-Carr	8874T18
115	TEE, 8MM x 8MM x 6MM	003660	Festo	153135
116	ELBOW, STR90, 8MM x 6MM	003648	Festo	153062
117	ADAPTER, 1/8MNPT x 8MM	003651	Festo	153004
118	VALVE, 3 WAY, 8MM	004224	Festo	153476
119	ADAPTER,1/8MNPTx6MM	003650	Festo	153002
120	TUBE, PUN, 6MM x 1MM, BLU	004218	Festo	159664
121	TUBE, PUN, 6MM x 1MM, RED	004219	Festo	178411
122	TUBE, PUN, 8MM x 1.25MM, BLU	004220	Festo	159666
123	TUBE, PUN, 8MM x 1.25MM, RED	004221	Festo	178412

Supplier Chart (continued)

Item	Description	SEI Part #	Alternate Supplier	Supplier Part #
124	CHANNEL, RBR, 1/8 x 5/16	003128	McMaster Carr	8507K65
125	SPRING, EXT, 0.250 x 0.021 x 1.00	005991	Century Spring	5509
126	BUSHING, ST, NY, 11/64 x 1/2 x 1/2	006389	McMaster Carr	94639A534
127	BUSHING, ST, NY, 1/4 x 1/2 x 5/8	005986	McMaster Carr	94639A572
128	BUSHING, ST, NY, 1/4 x 5/8 x 1/16	005138	McMaster Carr	96371A202
129	BUSHING, ST, NY, 1/4 x 1/2 x 3/16	005985	McMaster Carr	94639A568
131	GUARD, SWITCH, 1 x 1, 4-40	005139	McMaster Carr	1568A41
133	KNOB, ABS, 0.85 DIA, 1/8 SHAFT	001363	Newark in One	91F2243
134	WRENCH, HEX KEY, 1/8, T-HAND	003135	McMaster Carr	7041A13
135	WRENCH, HEX KEY, 2.5MM, T-HAND	003136	McMaster Carr	7041A42
136	CAP, BLACK	005996	Shaw	910-0934-03
137	CAP, BLUE	005995	Shaw	910-2121-01
138	FILTER, GLYCOL	006324	Festo	15889
139	FILTER, WATER	006236	Festo	160239
140	GASKET, FILLER NECK	006398	Shaw	910-0222-01
142	CAP, 6MM	003641	Festo	153263
200	SCREW, 10-32 x 1/4, SET, CUP, SS	000525	Fastenal	73245
201	SCREW, 6-32 x 7/8, SC, SS	000414	Fastenal	73417
202	SCREW, M3 x 10, SC, SS	000328	Fastenal	M82510010A40000
203	PIN, SPLIT, 3/16 x 1-1/4, SS	001739	Fastenal	74320
204	SCREW, 8-32 x 11/64, CAPTIVE, PH, SS	000523	McMaster-Carr	94350A145
205	SCREW, 6-32 x 3/4, MS, PNPH, SS	000484	Fastenal	72388
206	SCREW, 8-32 x 3/8, FSC, SS	000442	Fastenal	73851
208	SCREW, 10-32 x 1-1/4, SC, SS	000536	Fastenal	73452
207	SCREW, 8-32 x 1/4, SET, CUP, SS	000364	Fastenal	73225
209	SCREW, 8-32 x 1/2, SC, SS	000419	Fastenal	73422
210	PIN, SPLIT,1/8 x 1-1/4, SS	001738	Fastenal	74311
211	SCREW, 6-32 x 3/16, MS, PNPH, SS	000480	Fastenal	72500
212	SCREW, 10-24 x 3/8, BC, SS	000513	Fastenal	73731
213	BOLT, 1/4 x 3/4 x 10-32, SH, HX, SS	000557	McMaster Carr	94035A540
214	BOLT, 1/4 x 3/8 x 10-32, SH, HX, SS	000554	McMaster Carr	94035A535
215	SCREW, 10-32 x 3/8, SEAL, PNPH, SS	000546	Fastenal	11104543
216	SCREW, 8-32 x 1/8, SET, CUP, SS	000363	Fastenal	73223
217	SCREW, 8-32 x 1, SC, SS	000423	Fastenal	73425
218	NUT, NYL, 8-32, HX, SS	001659	Fastenal	70856
219	SCREW, 8-32 x 1/2, FSC, SS	000444	Fastenal	73852

Supplier Chart (continued)

Item	Description	SEI Part #	Alternate Supplier	Supplier Part #
220	PIN, SPLIT, 1/8 x 1/4, SS	001735	Fastenal	171515
221	PIN, SPLIT, 1/8 x 1, SS	001737	Fastenal	74310
222	SCREW, 8-32 x 3/8, MS, PNPH, SS	000487	Fastenal	72396
223	SCREW, 8-32 x 1, MS, PNPH, SS	000489	Fastenal	72418
224	SCREW, 8-32 x 1-3/4, MS, PNPH, SS	000490	Fastenal	72435
225	SCREW, 4-40 x 3/8, MS, PNPH, SS	000475	Fastenal	72482
226	SCREW, 10-32 x 3/8, MS, PNPH, SS	000545	Fastenal	72450
227	BOLT, 1/4 x 5/8 x 10-32, SH, HX, SS	000556	McMaster Carr	94035A539
228	NUT, NYL, 10-32, HX, SS	001685	Fastenal	70858
229	BOLT, 1/4 x 1/4 x 10-32, SH, HX, SS	000553	McMaster Carr	94035A534
230	NUT, CPL, 8-32 x 5/8, BR	001639	McMaster Carr	90308A640
231	SCREW, 8-32 x 1/4, MS, PNPH, SS	000486	Fastenal	72394
234	NUT, NYL, 4-40, HX, SS	001657	Fastenal	70854
235	SCREW, 1/4-20 x 1/2, BC, SS	000427	Fastenal	73459
236	NUT, KNUR, 10-24, BR	001638	McMaster Carr	92741A130
237	NUT, KNUR, 10-24, OX	001696	McMaster Carr	94775A021
238	BOLT, 3/8 x 1/2 x 1/4-20, SH, HX, SS	006411	McMaster Carr	94035A309
239	BUSHING, FL, BRZ, 3/8 x 1/2 x 5/16	005982		
240	WASHER, FLT, 3/8 x 3/4, BRZ	006412	McMaster Carr	5906K533
241	WASHER, FLT, 3/8 x 5/8, AN, SS	001835	McMaster Carr	RW4440020SS0000
242	WASHER, FLT, 1/4 x 5/8, SAE, SS	001819	Fastenal	0171977
243	NUT, JAM, NYL, 1/4-20, HX, SS	001663	Fastenal	0129156
301	STRAIN RELIEF, 1/2 MNPT	004863	McMaster Carr	69915K53
304	BATTERY, SLA, 12V x 0.8AH	000263	Powersonic	PS-1208
305	BOOT, TOGGLE SW, 1/4-40, BLK	001364	Digikey	360-1750-ND
306	BOOT, TOGGLE SW, M12, BLK	001365	Digikey	360-1606-ND
307	BOOT, TOGGLE SW, M12, RED	001366	Digikey	360-1707-ND
308	BOOT, TOGGLE SW, M12, YEL	001367	Digikey	360-1708-ND

Alternate Supplier Contacts

Century Spring Corp.
222 East 16th Street
Los Angeles, CA
90015
800-237-5225
www.centuryspring.com

Cords Canada Ltd.
62 Densley Avenue,
Toronto, ON
M6M 5E1
800-363-5080
www.cordscanada.com

Digi-Key Corporation
701 Brooks Ave. South
Thief River Falls, MN
56701
800-344-4539
www.digikey.com

Fastenal Industrial & Construction Supplies
National Chain of Stores
consult local yellow pages
www.fastenal.com

Festo Corporation
502 Earth City Expressway, Suite 125
Earth City, MO
63045
800-993-3786
www.festo.com

McMaster Carr Supply Company
200 New Canton Way
Robbinsville, NJ
08691-2343
609-689-3000
www.mcmaster.com

McMaster Carr Supply Company
6100 Fulton Industrial Blvd. SW
Atlanta, GA
30336-2853
404-346-7000
www.mcmaster.com

McMaster Carr Supply Company
200 Aurora Industrial Pkwy.
Aurora, OH
44202-8087
330-995-5500
www.mcmaster.com

McMaster Carr Supply Company
600 N County Line Rd.
Elmhurst, IL
60126-2081
630-833-0300
www.mcmaster.com

McMaster Carr Supply Company
9630 Norwalk Blvd.
Santa Fe Springs, CA
90670-2932
562-692-5911
www.mcmaster.com

NAPA Auto Parts
National Chain of Stores
consult local yellow pages
www.napaonline.com

Newark In One
4801 N. Ravenswood
Chicago, IL
60640-4496
800-463-9275
www.newark.com

Power-Sonic Corporation
7550 Panasonic Way
San Diego, CA
92154
619-661-2020
www.power-sonic.com

Stock Drive Products
2101 Jericho Tpke
New Hyde Park, NY
11042-5416
516-328-3300
www.sdp-si.com

Section 8: Warranty

SEI Industries Ltd. (the Company) agrees to grant a warranty for a period of two (2) years from the date of purchase of Dragon® Fire Ignition systems on the following conditions:

a) The company's sole obligation under this warranty is limited to repairing or replacing, at the company's sole discretion, any product proved to be defective.

b) The company's products are not guaranteed for any specific length of time or measure of service, but are warranted only to be free from defects in workmanship and material for a period of two (2) years to the original purchaser.

c) To the extent allowable under applicable law, the company's liability for consequential and incidental damages is expressly disclaimed. The company's liability in all events is limited to, and shall not exceed, the purchase price paid.

d) This warranty is guaranteed to the original purchaser of Dragon® Fire Ignition systems and does not extend to a subsequent purchaser or assignee.

e) The company must receive notification in writing of any claims of warranty from the original purchaser which must give details of the claimed defect in the product.

f) Where the original purchaser is claiming under warranty, the product must be returned to the company for inspection with all transportation and duty charges prepaid.

g) The warranty does not extend to any product that has been accidentally damaged, abraded, altered, punctured, abused, misused or used for a purpose which has not been approved by the company.

h) This warranty does not apply to any accessories used with the product that are not supplied by the company and any warranty on such accessories must be requested from the manufacturer or dealer of the accessories.

i) In the event the original purchaser does not give notice of a warranty claim within two (2) years of the original purchase of the product, it is understood that the purchaser has waived the claim for warranty and the purchaser and/or any subsequent purchaser must accept the condition of the product as it may be, without warranty.

j) Any technical information supplied by the company regarding the product is not a condition of warranty but, rather, is information provided by the company to the best of its knowledge.

k) There are no implied warranties nor is there any warranty that can be assumed from any representation of any person, except the company itself.

Exclusions

l) This warranty is void if the product is not installed, used and/or maintained in accordance with the operations manual supplied by SEI.

m) All Dragon® Fire Ignition systems are designed and manufactured with substantial safety margins. It is the responsibility of the user to ensure that the equipment is maintained to a safe standard.

Appendix

Canada Colors and Chemicals Limited

152 Kennedy Road South
Brampton, Ontario
Canada
L6W 3G4

General Inquiry Number: (905) 459-1232

Material Safety Data Sheet Attached

This product is distributed by
Canada Colors and Chemicals Limited
General Inquiry: (905) 459-1232
24 Hour Emergency: (416) 444-2112
CCC: Product Code: 754506
CCC: Product Name: POT. PERMANGANATE BP GRADE

MSDS # CP-103 **Revision Date: November 2010** **Supercedes: August 2010**

Section 1 Identification of the Substance/Preparation and of the Company/Undertaking

SUBSTANCE/PREPARATION NAME:	Potassium permanganate, $KMnO_4$
PRODUCT NAME:	CAIROX® Potassium Permanganate
TRADE NAME:	CAIROX® Potassium Permanganate
SYNONYMS:	Permanganic acid potassium salt, Chameleon mineral, Condy's crystal, Permanganate of potash
USES OF SUBSTANCE:	Potassium Permanganate is an oxidant recommended for applications that require a strong oxidant.

COMPANY NAME (Europe): CARUS EUROPE	**COMPANY ADDRESS:** **INFORMATION:** **EMERGENCY TELEPHONE:**	C/ Secundino Roces, 3-Planta 1ª – Oficina 14, 33428 Cayes – Llanera, Asturias - Spain + (34) 985-785-513 + (34) 985-785-513
COMPANY NAME (US): CARUS CORPORATION	**COMPANY ADDRESS:** **INFORMATION:** **EMERGENCY TELEPHONE:**	315 Fifth Street Peru, IL 61354, USA (815) 223-1500 (815) 224-6816 (FAX) www.caruscorporation.com (Web) salesmkt@caruscorporation.com (Email) (800) 435 –6856 (USA) (815) 223-1500 (Other countries) (800) 424-9300 (CHEMTREC®, USA) (703) 527-3887 (CHEMTREC®, Other countries)

Section 2 Hazards Identification

GLOBAL HARMONIZED SYSTEM (GHS) OF CLASSIFICATION OF THE SUBSTANCE

Oxidizing solid, Category 2
Acute toxicity, Category 4
Aquatic toxicity (acute), Category 1
Aquatic toxicity (chronic), Category 1

GHS LABEL ELEMENTS, INCLUDING PRECAUTIONARY STATEMENTS

Signal Word: DANGER
Label Codes: GHS03, GHS07, GHS09
Hazard Statements: H272, H302, H400, H410

H272	May intensify fire, oxidizer
H302	Harmful, if swallowed
H410	Very toxic to aquatic life with long lasting effects
P210	Keep away from heat/sparks/open flames/hot surfaces. – No smoking
P220	Keep/Store away from clothing/combustible materials.
P260	Do not breathe dust
P280	Wear protective gloves/protective clothing/eye protection/face protection
P370 + P378	In case of fire: Use water for extinction
P501	Dispose of contents/container to appropriate places
P273	Avoid release to the environment.

Section 2 Hazards Identification (contd.)

EU CLASSIFICATION
HAZARD SYMBOLS: **O, Xn, N**
RISK PHRASES: **8,22, 50/53**

HUMAN AND ENVIRONMENTAL HAZARDS

Contact with combustible material may cause fire.
Harmful if swallowed.
Very toxic to aquatic organisms may cause long-term adverse effects in the aquatic environment.

This substance is hazardous in the European Union according to the latest adaptations to Regulations (EC) No 1272/2008 and (EC) No 1907/2006.

OTHER HAZARDS

EYE CONTACT
Potassium Permanganate is damaging to eye tissue on contact. It may cause burns that result in damage to the eye.

SKIN CONTACT
Momentary contact of solution at room temperature may be irritating to the skin, leaving brown stains. Prolonged contact is damaging to the skin. Concentrated solutions at elevated temperature and crystals are damaging to the skin.

INHALATION
Acute inhalation toxicity data are not available. However, airborne concentrations of potassium permanganate in the form of dust or mist may cause damage to the respiratory tract.

INGESTION
Potassium Permanganate, if swallowed, may cause burns to mucous membranes of the mouth, throat, esophagus, and stomach.

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM (HMIS) RATINGS
Health: 1 - Slight
Flammability: 0 - None
Reactivity: 0 - None
Personnel Protective Equipment: goggles face shield, apron, respirator and proper gloves.

Section 3 Composition/Information on Ingredients

CAS#	Component / EC#	Percent	Symbols	Risks
7722-64-7	Potassium permanganate 231-760-3	>97.5	Xn N O	8,22, 50/53

Component Related Regulatory Information
This product may be regulated, have exposure limits or other information identified as the following: Permanganates, inorganic, n.o.s., Manganese compounds, inorganic

Substance Registration Number(s)
This material is produced in amounts > 1 tonne/annum and is therefore subject to REACH registration.
01-2119480139-34-0000

Section 4 First Aid Measures

EYES
Immediately flush eyes with large amounts of water for at least 15 minutes holding lids apart to ensure flushing of the entire surface. Do not attempt to neutralize chemically. Seek medical attention immediately. **Note to physician**: Decomposition products are alkaline. Insoluble decomposition product formed is brown colored manganese dioxide.

SKIN
Immediately wash contaminated areas with water. Remove contaminated clothing and footwear. Wash clothing and decontaminate footwear before reuse. Seek medical attention immediately if irritation is severe or persistent.

INHALATION
Remove person from contaminated area to fresh air. If breathing has stopped, resuscitate and administer oxygen if readily available. Seek medical attention immediately.

INGESTION
Never give anything by mouth to an unconscious or convulsing person. If person is conscious, give large quantities of water. Seek medical attention immediately.

NOTE TO PHYSICIANS
For inhalation, consider oxygen.
Avoid gastric lavage or emesis.
Decomposition products are alkaline. Insoluble decomposition product formed is brown colored manganese dioxide.

Section 5 Fire Fighting Measures

NFPA* HAZARD SIGNS

Health Hazard	1	=	Materials that under emergency conditions, can cause significant irritation. Materials that on the skin could cause irritation.
Flammability Hazard	0	=	Materials that will not burn under typical fire conditions, including intrinsically noncombustible materials such as concrete, stone and sand.
Instability Hazard	0	=	Materials that in themselves are normally stable, even under fire conditions.
Special Hazard	OX	=	Oxidizer

***National Fire Protection Association 704 (USA)**

FIRST RESPONDERS
Wear protective gloves, boots, goggles, and respirator. In case of fire, wear positive pressure breathing apparatus. Approach incident with caution.

FLASHPOINT
None

FLAMMABLE OR EXPLOSIVE LIMITS
Lower: Nonflammable Upper: Nonflammable

EXTINGUISHING MEDIA
Use large quantities of water. Water will turn pink to purple when in contact with potassium permanganate. Dike to contain. Do not use dry chemicals, CO_2, Halon® or foams, because they are not effective.

SPECIAL FIREFIGHTING PROCEDURES
If material is involved in fire, flood with water. Cool all affected containers with large quantities of water. Apply water from as far a distance as possible. Wear self-contained breathing apparatus and full protective clothing.

Section 5 Fire Fighting Measures (contd.)

UNUSUAL FIRE AND EXPLOSION
Powerful oxidizing material. May decompose spontaneously if exposed to heat (135°C / 275°F). May be explosive in contact with certain other chemicals (Section 10). May react violently with finely divided and readily oxidizable substances. Increases burning rate of combustible material.

THERMAL DECOMPOSITION PRODUCTS:
Combustion: oxides of potassium, oxides of manganese. Fire may product irritating, poisonous and/or corrosive fumes.

Section 6 Accidental Release Measures

OCCUPATIONAL SPILL/RELEASE
Avoid contact with combustible materials. Do not touch spilled material. Move containers away from spill to a safe area. Keep unnecessary people away, isolate hazard area and deny entry.

PERSONAL PRECAUTIONS
Ensure adequate ventilation. Avoid dust formation. Personnel should wear protective clothing suitable for the task. Remove all ignition sources and incompatible materials before attempting clean up.

ENVIRONMENTAL PRECAUTIONS
Do not flush into sanitary sewer system or surface water. If accidental release into the environment occurs, inform the responsible authorities. Keep the product away from drains, sewers, surface and ground water and soil.

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED
Clean up spills immediately by sweeping or shoveling up the material. Do not return spilled material to the original container; transfer to a clean metal or plastic drum. To clean up potassium permanganate solutions, follow either of the following two options.

Option # 1: Dilute to approximately 6% with water, and then reduce with sodium thiosulfate, a bisulfite or ferrous salt solution. The bisulfite or ferrous salt may require some dilute sulfuric acid (10% w/w) to promote reduction. Neutralize with sodium carbonate to neutral pH, if acid was used. Decant or filter and deposit sludge in approved landfill. Where permitted, the sludge may be drained into sewer with large quantities of water.
Option # 2: Absorb with inert media like diatomaceous earth or inert floor dry, collect into a drum and dispose of properly. Does not use saw dust or other incompatible media. Disposal of all materials shall be in full and strict compliance with all federal, state, and local regulations pertaining to permanganates.

To clean contaminated floors, flush with abundant quantities of water into sewer, if permitted by federal, state, and local regulations. If not, collect water and treat as described above.

Section 7 Handling and Storage

WORK/HYGIENIC PRACTICES
Wash hands thoroughly with soap and water after handling potassium permanganate. Do not eat, drink or smoke when working with potassium permanganate. Wear proper protective equipment. Remove clothing if it becomes contaminated.

VENTILATION REQUIREMENTS
Provide sufficient mechanical and/or local exhaust to maintain exposure below the TLV/TWA.

CONDITIONS FOR SAFE STORAGE
Store in accordance with NFPA 430 requirements for the Storage of Class II oxidizing materials. Protect containers from physical damage. Store in a cool, dry area in closed containers. Segregate from acids, peroxides, formaldehyde, and all combustible, organic, or easily oxidizable materials including antifreeze and hydraulic fluid.

Section 8 Exposure Controls and Personal Protection

COMPONENT EXPOSURE LIMITS

Potassium permanganate (7722-64-7)

ACGIH: 0.2 mg/m3 TWA (as Mn)

VENTILATION

Provide local exhaust or process enclosure ventilation system. Ensure compliance with applicable exposure limits.

PERSONAL PROTECTIVE EQUIPMENT

EYES/FACE

Face shield, goggles, or safety glasses with side shields should be worn. Provide eyewash in working area.

GLOVES

Rubber or plastic gloves should be worn.

OTHER PROTECTIVE EQUIPMENT

Chemically resistant clothing covering arms and legs, and rubber or plastic apron should be worn. **Caution:** If clothing becomes contaminated, wash off immediately.

RESPIRATORY PROTECTION

In cases where overexposure to dust may occur, the use of an approved NIOSH-MSHA dust respirator or an air supplied respirator is advised. Engineering or administrative controls should be implemented to control dust.

Measurement Element: Manganese (Mn)

10 mg/m3

Any particulate respirator equipped with an N95, R95, or P95 filter (including N95, R95, and P95 filtering facepieces) except quarter-mask respirators. The following filters may also be used: N99, R99, P99, N100, R100 or P100.

Any supplied-air respirator.

25 mg/m3

Any supplied-air respirator operated in a continuous-flow mode.

Any powered, air-purifying respirator with a high-efficiency particulate filter.

50 mg/m3

Any air-purifying, full-facepiece respirator equipped with an N100, R100, or P100 filter.

Any supplied-air respirator with a tight-fitting face piece that is operated in a continuous-flow mode.

Any powered, air-purifying respirator with a tight-fitting face piece and a high-efficiency particulate filter.

Any self-contained breathing apparatus with a full face piece.

Any supplied-air respirator with a full face piece.

500 mg/m3

Any supplied-air respirator operated in a pressure-demand or other positive-pressure mode.

Emergency or planned entry into unknown concentrations or IDLH conditions -

Any self-contained breathing apparatus that has a full face piece and is operated in a pressure-demand or other positive-pressure mode.

Escape

Any air-purifying, full-face piece respirator equipped with an N100, R100, or P100 filter.

Any appropriate escape-type, self-contained breathing apparatus.

Section 9 Physical and Chemical Properties (CONTD.)

APPEARANCE	Dark purple solid with metallic luster
ODOR	Odorless
pH OF THE SUBSTANCE	Not applicable
BOILING POINT/BOILING RANGE	Not applicable
FLASH POINT	Not applicable
FLAMMABILITY (SOLID, GAS)	Not flammable
EXPLOSIVE PROPERTIES	Explosive in contact with sulfuric acid or peroxides, or readily oxidizable substances
OXIDIZING PROPERTIES	Strong oxidizer
VAPOR PRESSURE	Not applicable
RELATIVE DENSITY (AT 20°C)	2.7
SOLUBILITY	
WATER SOLUBILITY	6% (by weight) at 20°C and 20% (by weight) at 65°C
PARTITION COEFFICEINT: n-OCTONAL/WATER	
VISCOSITY	Not applicable
VAPOUR DENSITY	Not applicable
EVAPORATION RATE	Not applicable
MELTING POINT	Starts to decompose with evolution of oxygen (O_2) at temperatures above 150°C. Once initiated, the decomposition is exothermic and self sustaining.
MOLECULAR WEIGHT	158.034

Section 10 Stability and Reactivity

STABILITY
Under normal conditions, the material is stable.

CONDITIONS TO AVOID
Contact with incompatible materials or heat (150°C / 302ºF) could result in violent exothermic chemical reaction.

MATERIALS TO AVOID
Acids, peroxides, formaldehyde, anti-freeze, hydraulic fluids and all combustible organic or readily oxidizable inorganic materials including metal powders. With hydrochloric acid, chlorine gas is liberated.

HAZARDOUS DECOMPOSITION PRODUCTS
When involved in a fire, potassium permanganate may liberate irritating, poisonous and/or corrosive fumes. Oxides of potassium and manganese may be formed.

CONDITIONS CONTRIBUTING TO HAZARDOUS POLYMERIZATION
Material is not known to polymerize.

Section 11 Toxicological Information

EXPOSURE SYMPTOMS DESCRIPTION

INHALATION
The product may be absorbed into the body by inhalation. Major effects of exposure: respiratory disorder, cough.

INGESTION
Harmful, if swallowed. The estimated lethal human dose is 10 g. Ingestion may cause nausea, vomiting, sore throat, stomach-ache, and eventually lead to a perforation of the intestine. Liver and kidney injuries may occur.

Section 11 Toxicological Information (contd.)

SKIN CONTACT

The product may be absorbed into the body through the skin. Major effects of exposure: severe irritation, damage to the skin, and brown staining of skin.

EYE CONTACT

Contact with eye is damaging to eye tissues. It may cause severe burns that result in damage to the eye.

ACUTE TOXICITY

LC 50 inhalation: No data available.
LD 50 dermal: No data available.
LD 50 oral rat: 780 mg/kg male (14 days); 525 mg/kg female (14 days).
Harmful if swallowed. ALD: 10g. Ingestion may cause nausea, vomiting, sore throat, stomach-ache and eventually lead to a perforation of the intestine. Liver and kidney injuries may occur.

CHRONIC TOXICITY

No known cases of chronic poisoning due to permanganates have been reported. Prolonged exposure, usually over many years, to heavy concentrations of manganese oxides in the form of dust and fumes may lead to chronic manganese poisoning, chiefly involving the central nervous system.

CARCINOGENICITY

Potassium permanganate has not been classified as a carcinogen by ACGIH, NIOSH, OSHA, NTP, or IARC.

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE

Potassium permanganate will cause further irritation of tissue, open wounds, burns or mucous membranes.

Section 12 Ecological Information

ECO TOXICITY

Very toxic to aquatic organisms.

COMPONENT ANALYSIS - AQUATIC TOXICITY

Potassium permanganate (7722-64-7)

96Hr LC50	Rainbow trout	1.8 mg/L
96Hr LC50	Bluegill sunfish	2.3 mg/L
96Hr LC50	Milk fish (Chanos Chanos	>1.4 mg/L
96Hr LC50	Carassius auratus	3.3-3.93 mg/L (static)
96Hr LC50	Cyprinus carpio	2.97-3.11 mg/L
96Hr LC50	Cyprinus carpio	3.16-3.77 mg/L
96Hr LC50	Lepomis macrochirus	2.3 mg/L (flow-through)
96Hr LC50	Lepomis macrochirus	1.8-5.6 mg/L (static)
96Hr LC50	Lepomis macrochirus	2.7 mg/L (static)
96Hr LC50	Oncorhynchus mykiss	1.08-1.38 mg/L
96Hr LC50	Oncorhynchus mykiss	0.77-1.27 mg/L

MOBILITY

Miscible in water.

PERSISTENCE AND DEGRADABILITY

Permanganate has a low estimated lifetime in the environment, being readily converted by oxidizable materials to insoluble MnO_2.

Section 12 Ecological Information

BIOACCULUMATIVE POTENTIAL

In non-reducing and non-acidic environments, MnO_2 is insoluble and has a very low bioaccumulative potential.

OTHER ADVERSE EFFECTS

Harmful to aquatic organisms.

Section 13 Disposal Considerations

WASTE DISPOSAL

Offer surplus and non-recyclable product or solutions to a licensed disposal company. Disposal of all materials shall be in full and strict compliance with all federal, state, and local regulations. This material and its container must be disposed of as hazardous waste. US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. When it becomes a waste, potassium permanganate is considered a D001 hazardous (ignitable) waste. For disposal of potassium permanganate solutions, follow procedures in Section 6 and deactivate the permanganate to insoluble manganese dioxide. Dispose of it in a permitted landfill. Contact Carus Corporation for additional recommendations. Packaging materials must be triple rinsed to remove all residues prior to re-cycling or disposal as a non-hazardous waste.

RCRA P-Series: None listed. **RCRA U-Series:** None listed.

Section 14 Transport Information

USA (Land, DOT) and Canada (TDG)	**ID Number:**	UN 1490
	Proper Shipping Name:	Potassium permanganate
	Hazard Class:	Oxidizer
	Packing Group:	II
	Division:	5.1
	Product packaging containing ≥100 lbs	
	ID Number:	UN 1490
	Proper Shipping Name:	Potassium permanganate, RQ
	Hazard Class:	Oxidizer
	Packing Group:	II
	Division:	5.1
	Additional Info.: If this product is spilled or leaked into the environment, the CERCLA (40 CFR 302.4) reportable quantity is 100 lbs, and requires National Response Center notification within United States of America.	
European Labeling in accordance Road/Rail Transport (ADR/RID)	**ID Number:**	UN 1490
	ADR/RID Class:	5.1
	Description of Goods:	Potassium permanganate
	Packing Group:	II
	Hazard Identification No.:	50
European Labeling in accordance with EC directive (Water, IMDG)	**ID Number:**	UN 1490
	Proper Shipping Name:	Potassium permanganate
	Hazard Class:	Oxidizer
	Packing Group:	II
	Division:	5.1
	Marine Pollutant:	No
European Labeling in accordance with EC directive (IACO, IATA)	**ID Number:**	UN 1490
	Proper Shipping Name:	Potassium permanganate
	Hazard Class:	Oxidizer
	Packing Group:	II
	Division:	5.1

Section 15 Regulatory Information

EUROPEAN AND INTERNATIONAL REGULATIONS
GERMANY WATER CLASSIFICATION
Potassium permanganate (7722-64-7)
Number 1936, hazard class 3 - severe hazard to waters

CLP CLASSIFICATION
This product is hazardous according to the Regulation (EC) No. 1272/2008 on Classification, Labeling and Packaging of Substances and Mixtures (CLP).

Oxidizing solid, Category 2
Acute toxicity, Category 4
Hazardous to the Aquatic Environment - Hazard, Category 1
Hazardous to the Aquatic Environment - Hazard, Category 1

CLP HAZARD SYMBOLS

CLP HAZARD STATEMENTS

H272	May intensify fire, oxidizer
H302	Harmful, if swallowed
H410	Very toxic to aquatic life with long lasting effects
P210	Keep away from heat/sparks/open flames/hot surfaces. – No smoking
P220	Keep/Store away from clothing/combustible materials.
P260	Do not breathe dust
P280	Wear protective gloves/protective clothing/eye protection/face protection
P370 + P378	In case of fire: Use water for extinction
P501	Dispose of contents/container to appropriate places
P273	Avoid release to the environment.

COMPONENT ANALYSIS – INVENTORY

COMPONENT	CAS#	US	CA	EU	AU	PH	JP	KR	CN	NZ
Potassium permanganate	**7722-64-7**	**TSCA**	**DSL**	**EIN**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**

This product has also been classified in accordance with the hazard criteria of the Controlled Products Regulation (CPR, Canada) and the MSDS contains all of the information required by the CPR.

Section 15 Regulatory Information (contd.)

US FEDERAL REGULATIONS:

FEDERAL, STATE & INTERNATIONAL REGULATIONS – PART 1

Ingredient	CAS. NO.	SARA 302 RQ	SARA 302 TPQ	SARA 313 List	SARA 313 Chemical Category
Potassium permanganate	7722-64-7	No	No	Yes	Yes (Manganese compounds)

FEDERAL, STATE & INTERNATIONAL REGULATIONS – PART 2

Ingredient	CAS. NO.	CERCLA	RCRA	TSCA 8(d)
Potassium permanganate	7722-64-7	Yes (RQ = 100 lbs)	D001	No

Ingredient	CAS. NO.	CWC	TSCA 12(b)	CDTA	SARA 311/312
Potassium permanganate	7722-64-7	No	No		4545 Kg

Ingredient	CAS. NO.	Acute	Chronic	Fire	Pressure	Reactivity	Pure/Liquid
Potassium permanganate	7722-64-7	Yes	Yes	Yes	No	No	Pure

Ingredient	CAS. NO.	Australian Hazchem	WHMIS	IDL
Potassium permanganate	7722-64-7	IYE	C, D2B	Yes

Section 16 Other Information

ADR/RID	Agreement on Dangerous Goods by Road /Regulations Concerning the International Transport of Dangerous Goods by Rail
C	Ceiling Exposure Limit
CAS	Chemical Abstract Service
CFR	Code of Federal Regulations
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CHEMTREC	Chemical Transportation Emergency Center
EINECS	Inventory of Existing Chemical Substances (European)
DOT	Department of Transportation
DSL/NDSL	The Domestic Substances and the Non-Domestic Substances List (Canada)
HIMS	Hazardous Materials Information System
IARC	International Agency for Research on Cancer
IATA	International Air Transport Association
ICAO	International Civil Aviation Center
IDL	Ingredient Disclosure List
IMDG	International Maritime Dangerous Goods
OSHA	Occupational Safety and Health Administration
NIOSH	National Institute for Occupational Safety and Health
NTP	National Toxicology Program
MSHA	Mine Safety and Health Administration
PEL	Permissible Exposure Limit
SARA	Superfund Amendments and Reauthorization Act
TDG	Transport Dangerous Goods (Canada)
TSCA	Toxic substances control Act
TLV-TWA	Threshold Limit Value-Time Weighted Average
UN	United Nations
WHMIS	Workplace Hazardous Materials Information System

Section 16 Other Information (contd.)

The information contained herein is accurate to the best of our knowledge. However, data, safety standards and government regulations are subject to change and, therefore, holders and users should satisfy themselves that they are aware of all current data and regulations relevant to their particular use of product. CARUS CORPORATION DISCLAIMS ALL LIABILITY FOR RELIANCE ON THE COMPLETENESS OR ACCURACY OR THE INFORMATION INCLUDED HEREIN. CARUS CORPORATION MAKES NO WARRANTY, EITHER EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY WARRANTIES OF MERCHANTIABILITY OR FITNESS FOR PARTICULAR USE OR PURPOSE OF THE PRODUCT DESCRIBED HEREIN. All conditions relating to storage, handling, and use of the product are beyond the control of Carus Corporation, and shall be the sole responsibility of the holder or user of the product.

This safety data sheet was reviewed according to Annex II of the regulation of the European Parliament and European Council (EC) No. 1907/2006-REACH and 1272/2008.

CARUS CORPORATION, 315 5TH STREET, PERU, ILLINOIS 61354, USA
CARUS EUROPE IS A DIVISION OF CARUS CORPORATION

Chithambarathanu Pillai (S.O.F.)
November 2010

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OUR COMMITMENT TO SUSTAINABILITY

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